Teaching and Learning Mathematics

A Base Line Study of Individually Adapted Education According to the Diversity of Pupils in a Third Grade of Primary School

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Abstract

This study concerned itself with teaching and learning of the subject of mathematics. It was a base line study of individually adapted education according to the diversity of pupils. The study was grounded on aspects of the Curriculum Relation Model developed by Johnsen (2001, 2003 & 2007). The Model was used for presentation of related literature which included theoretical aspects and previous studies in the field of mathematics. It was also used as a main inspiration tool for further development of arenas and sub-arenas in the analysis and presentation of findings.

The purpose of the study was to investigate how the teacher managed to teach mathematics to all pupils with different educational needs, which challenges the teacher met in this process and how the teacher overcame them. These questions were investigated through a single case study. The study was conducted in the purposefully selected primary school with one teacher in the third grade class taken from a primary school in the Canton of Sarajevo, Bosnia and Herzegovina. In order to get in-depth information from different angels, the study included observation, interview and texts and materials analysis as research methods.

The findings obtained showed that assessment was a crucial pre-requisite for adapting teaching to the diversity of learners. The teacher followed the mathematics curriculum prescribed by authorities and she used time in deciding how to teach. Even though the long-term objective was the same for all pupils, the teacher meant that pupils should progress at their individual pace of learning. Thus, the teacher adapted teaching plan and program according to the diversity of the pupils. Regarding teaching strategies, the teacher used a variety of methods, classroom organization and teaching materials. The principle of scaffolding and direct engagement of pupils in class activities was evident during the lessons. The teacher and the pupils exchanged guiding roles of teaching and in that way peer support was expressed fully, as well as balancing of classroom organization. The teacher also conducted individual teaching, extra teaching and out of school activities with the purpose of giving additional support to learning. Findings regarding care and communication showed that the teacher paid attention to pupils' emotional and psychological needs. The study also revealed that the teacher met some challenges that she experienced as dilemmas and problems. The teacher expressed dilemmas regarding all aspects of teaching-learning process and found problems within frame factors, but tried her best to confronted most of them.

The Curriculum Relation Model (Johnsen 2001, 2003 & 2007) is proposed as a possible solution and base for planning, practicing and assessment of teaching-learning process in mathematics.

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Dedication

This thesis is dedicated to:

My father to whom I owe for my career to what I am today and who unfortunately did not live to witness my growth

Preface

Equal and quality primary education is a basic human right for all children. Mathematics is viewed as one of the basic skills that are taught in primary schools because of its importance for daily life and future work. In the process of teaching and learning mathematics teachers play a crucial role. How does the teacher manage to teach mathematics to all pupils according to their individual needs? Which challenges does the teacher meet in this process and how does the teacher confront them? These questions were what this study attempted to answer.

Thus, the study is divided into five chapters which describe and discuss the phenomenon studied and the process of studying it.

Chapter 1 is composed of three parts. The first part describes the topic while clarifying the key terms. The second part focuses on BiH, where this study was conducted, while the third part presents the rationale of the study taking into consideration the significance and justification of this study, as well as the research questions.

Chapter 2 traces review of literature which includes some theoretical aspects and previous studies about teaching and learning of mathematics. An issue of teaching-learning mathematics is presented throughout main arenas of a Curriculum Relation Model developed by Johnsen (2001, 2003 & 2007).

Chapter 3 discusses the research methodology taking into consideration the research design, process of data collection and the data analysis. The chapter describes modification of the Curriculum Relation Model and embedded arenas of analysis and presentation. The chapter finishes with the issue of ethical consideration. Validity issue and limitations are also taken into consideration.

Chapter 4 contains a presentation of analyzed findings according to the research questions. Findings as answers on the research questions are presented throughout 10 arenas of the modified Curriculum Relation Model.

Chapter 5 is based on discussions of major findings, summary and some of the conclusions derived from the findings. Reflections and suggestions for possible actions and for future research are cited at the end of this study.

List of Abbreviations

(In Alphabetical order)

Art.	Article
BiH	Bosnia and Herzegovina
CRM	Curriculum Relation Model
etc.	et cetera (Latin phrase) = and so forth
e.g.	exempli gratia (Latin phrase) = for example
EENET	Enabling Education Network
FBiH	Federation of Bosnia and Herzegovina
FL	Framework Law on Primary and Secondary Education in BiH
i.e.	id est (Latin phrase) = that is
ICPD	International Child Development Project
LP	Law on Primary Education of Canton Sarajevo
NCTM	National Council of Teachers of Mathematics
NLS	National Centre for Educational Resources, Norway
OFSTED	Office for Standards in Education (Britain)
OSCE	Organization for Security and Co-operation in Europe
RS	Republika Srpska (Republic of Serbs)
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

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CHAPTER 1: Background of the Study

Introduction

This study is about teaching and learning of the subject of mathematics. It is a base line study of individually adapted education according to the diversity of pupils in a third grade mathematical class, selected from a primary school in the Canton of Sarajevo, Bosnia and Herzegovina (BiH). Chapter 1 consists of three parts. The first part presents the situation in the field and describes the topic while clarifying the key terms. The second part focuses on BiH, where this study was conducted, taking into account: geographic and demographic information, the structure of the educational system and the role of the teachers and the on-going processes of the reform with special attention given to the current situation and issues concerning primary education. Based on the background information, the third part presents the rationale of the study taking into consideration the significance and justification of the study, as well as the research questions.

1.1 Field Conditions

1.1.1 Mathematics as Part of Basic Education

In order to successfully surmount the process of growing up, children need to acquire multiple types of knowledge. This process passes through phases of participating in social life and organized interceding by educators in institutions. Although these two phases of learning are tied and linked mutually, the focus in this study is on the second of the phases; on the process of teaching and learning within basic primary education.

Basic primary education is ‘a universal aspiration’ (Alexander 2000, p. 49) and a basic human right for all children, as stated in the United Nations (UN) *Convention on the Rights of the Child* (1989). The importance of basic education is widely recognized. Thus, different international summits, conferences, sessions, meetings, and committees have developed different documents, conventions, programmes and projects. UN

Educational Scientific and Cultural Organization (UNESCO) and the UN play the most important role in this effort. They set common targets for *World Declaration on Education for All and Framework for Action* (1990) and *United Nations Millennium Declaration* (2002) which should be realized in 2015.

Mathematics, together with literacy, has captured a significant place in these events and documents. Therefore, mathematics is viewed as one of the basic skills that are taught in primary schools. Through the use of abstraction and logical reasoning, mathematics includes systematic and continuous study of counting, calculation, measurement and shapes of objects. Thus, knowledge and use of basic mathematical skills are important for daily life and for future work. Liebeck (1984 & 1995) underlined several reasons for learning mathematics: (a) It is useful and serves in everyday life, science, business and industry; (b) It is a powerful, concise and unambiguous resource of communication, explanation and estimation; (c) It develops logical thinking; (d) It gives intellectual and esthetical pleasure. Heymann 2003 (in Noyes 2008) answered the question 'why teach mathematics?' by emphasizing its necessity for preparation for later life, promotion of cultural competence, developing an understanding of the world, promotion of understanding, cognitive skills and critical thinking, as well as for enhancing the students' self-esteem through willingness to assume responsibility, communication and cooperation.

1.1.2 Traditional versus Individually Adapted Education

Mathematics is often regarded as an indicator of school failure (Mulić 2005), which perpetuates the myth that mathematics is relatively difficult. The difficulties of mathematics in school are broadly recognized (Andrilović & Čudina 1988; Gezahegn 2007; Gifford 2005; Ostad 1999 & 2001; Reikerås 2006; Sohee 2003; Westwood 2003 & 2004; Yetkin 2003). Westwood (2003) emphasized that approximately 6 % of pupils have some significant difficulties in learning basic mathematical concepts and skills. Similarly, research by Ostad (1999) showed that about 10 % of pupils in primary schools need some remedial programs in mathematics.

Who is the culprit for this? Where should we search for the reasons to why pupils fail due to difficulties and low achievement? Two possible approaches may give an answer to this question: traditional and individually adapted education. The old, traditional class presented discipline-oriented education (Johnsen 2001 & 2003) as a model based on the understanding of the difficulties where pupils are seen to have problems and that they have to change and adapt to the system (Figure 1). The alternative to this approach is individual adapted education, which claims that difficulties are to be found in the educational system and that the system must be adapted to the individual needs of all children (Figure 2). According to Cerić and Alić (2005), depending on these approaches, educational systems can be organized as dual systems or incorporated systems (Appendix 1).

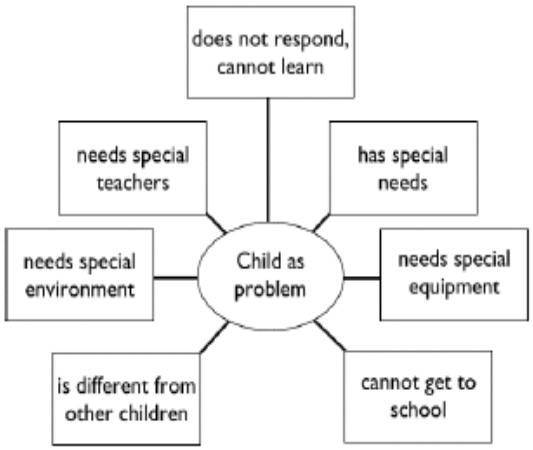


Figure 1: Traditional Education

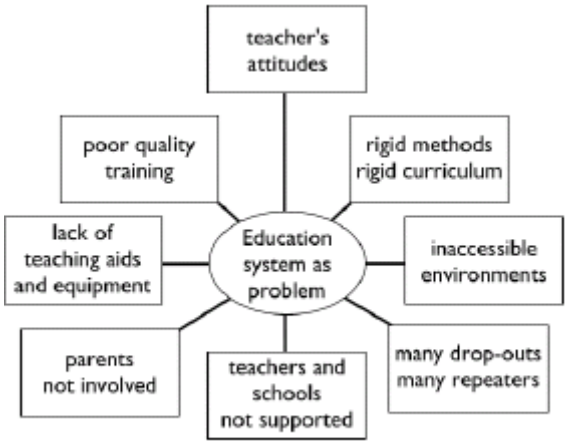


Figure 2: Individually Adapted Education

(Modified from EENET 1998)

1.1.3 Diversity of Pupuls

The term individual adaptation relates in this study to education of all pupils including those with disabilities, recognizing individual differences between pupils. Muminović (1998) emphasized studies which showed the differences of pupils who attended the same class. Some of them are presented as follows:

- There may be a difference of 37, 5 kg in weight and 38 cm in height among pupils aged fourteen.

- Pupils of the same age may have a difference in intellectual abilities ranging from six to sixteen years of mental ages. Also, pupils who have the same intelligence quotient may differ from each other in specific abilities from four to six years.
- Pupils may differ in prior knowledge. Research in The Republic of Croatia showed that pupils in fifth grade class of primary school had mathematical knowledge similar to the pupils from the third to eighth grades.
- Pupils may have different personality traits: tenacity, persistence, responsibility, ambition, and flexibility in thinking, sensitivity for problems, stability, self-esteem, as well as attitudes towards learning, teaching, class, development and education.
- Pupils with developed mathematical abilities differ according to: ability for formalization of lessons, ability for generalization of mathematical terms, differentiation between essential and unsubstantial components, discovering general in exterior, ability of handling of numbers and symbols etc...

So, the pupils in a class may differ on many levels even if they are chronologically at the same age (Andrilović & Čudina 1988; Befring 2001; Campbell & Fairbairn 2005; Cerić & Alić 2005; Johnsen 2001, 2003 & 2007; Orton 2004; Ruthven 2001; Tomlinson 1995; Vygotsky 1978). They come from different cultural backgrounds and have different abilities and learning styles. Their maturity and knowledge are different, they learn at different rates, and have different social and communication skills, as well as different interests and emotional readiness. This also includes disability in inclusive classes. In that sense, we can speak about the diversity of pupils in one classroom.

1.1.4 Individually Adapted Education

Although pupils' individual differences present rich possibilities for creative, dynamic and active teaching (Muminović 1998), they also present complexities in the teaching-learning process. Diversity of pupils, in addition to principles of equality and quality education for all, implies individual adaptation as essential in the teaching-learning process. In order to meet the diversity of pupils' needs, every element in the learning-teaching process – syllabus, working methods and activities, organization and learning materials and aids – must be implemented and adapted (Muminović 1998; NLS 1999).

The concept of individually adapted education is usually termed as individualization and differentiation; and it involves altering the instructional environment to correspond to the individual educational needs of each pupil in the classroom (Ornstein 1995). The importance of individually adapted education has been recognized also in educational system in BiH.

1.2 Background Information about BiH

1.2.1 Geographical and Demographic Information about BiH

This study was conducted in BiH which is situated in the heart of south-eastern Europe, in the Balkan Peninsula (Appendix 2a). Before 1992, BiH was one of the federal states of the former Yugoslavia. In 1992, BiH became an independent state. After the war, according to the *Dayton Peace Agreement* (1995, Annex 4), BiH was divided into three parts: two Entities (the Republika Srpska, RS; and the Federation of Bosnia and Herzegovina, FBiH) and the Brčko District. According to the *Constitution of the FBiH* (1997), each Entity has its own political structure and administration, with an overarching central government. The FBiH is further divided into 10 cantons (Appendix 2b) with a total of 73 municipalities. The RS has no cantons, but contains 64 municipalities[1].

BiH has a rich history, culture and natural beauty. Two of BiH's natives have been awarded with Nobel Prizes: Vladimir Prelog, for chemistry in 1975, and Ivo Andrić, for literature in 1961. About four million inhabitants live in BiH (according to the last census taken in 1991). The capital city is Sarajevo, fondly remembered for hosting the Winter Olympics in 1984. According to the *Constitution of BiH* (1995), the country is home to three ethnicities 'constituent peoples': Bosnians, Croats, and Serbs (along with others citizens and minority groups). Official language in BiH is Bosnian, Serbian and Croatian. (Federal Office of Statistics BiH 2008).

[1] The municipalities are local, administrative units.

1.2.2 Primary Education in Bosnia and Herzegovina

The last war and the subsequent disintegration, greatly affected the educational system throughout BiH. Thus, the *Constitution of BiH*[2] (1995) transfers educational issues to the entities. Each canton can transfer authorities concerning education to municipalities, and is obliged to do so *(Constitution of the FBiH* 1997). This leaves the country with no central body to co-ordinate educational matters, but instead with 13 ministries and some municipal representatives involved in education.

The educational system in BiH is organized on six levels (Appendix 3), from pre-school, through primary and secondary education, up to Doctoral Studies. Education[3] was increased to nine years of primary school in September 2004 and follows generation of pupils who attended school on 2004/2005 school year and who will finish primary education on 2012/2013 school year based on the reformed strategy[4]. Primary school lasts for nine years and is divided into two cycles: (1) the first cycle is from the first to the sixth grade, and (2) the second cycle is from the seventh to ninth grades. The first circle is also divided into two smaller cycles, referred to as the beginning and middle cycles. The beginning cycle is organized in the duration of three years of class instruction[5]. Emphasis here is on the development of basic abilities, knowledge and skills together with fundamental education aimed at the acquisition of standardized levels of knowledge in writing, reading and numeration. Pupils' achievements are descriptively graded based on defined Learning Outcomes[6] of particular subjects. Numerical grades are derived at the end of this cycle *(Concept of Nine – Years Primary Education* 2004). The middle cycle lasts for three years and comprises fourth, fifth and sixth grades. There is a combination of class and subject teaching. The last cycle, namely third or upper primary level, lasts for three years from the seventh to ninth grades. This is realized entirely with subject teaching.

[2] ...formulated in Annex 4 of *Dayton Peace Agreement* (1995).
[3] This study was conducted in a primary school and therefore only primary school educational system is presented here.
[4] In parallel there is an eight year educational system also for the pupils who attended school in previous years.
[5] One teacher teaches the same class throughout the school year (Hrasnica, Babić & Topić 2005, p. 344)
[6] "Outcomes describe what students must know, what students must be like and be able to do" (Bigge & Stump with Spagna & Silberman 1999, p. 36)

Teachers in primary school are professionals qualified in planning, preparing, organizing, realizing and evaluating educational work and different educational programmes (*Concept of Nine- Year Primary Education* 2004). They play an important role in preparing young people to face challenges in their future and, thus, their education and professional development is an important issue. Pre-service education for teachers in BiH is exhibited by a variety of institutions and years of studies (Appendix 4). The education of teaching personnel for the first five years of primary schools (usually referred to in the BiH educational system as lower grades) is performed at the Academies of Pedagogy and the Pedagogical and Teachers' Faculties for the duration of two or four years. Teachers cover generally, all subjects for classes in the lower grades (Appendix 5). Exceptions are made for Religious and English classes which are taught by teachers specialized for these subjects. From the sixth grade on, separate subjects are taught by different teachers who are specialized in specific subjects. The professional development (in-service education) of teachers in BiH consists of obligatory *collective* and *individual* professional development, and is almost entirely governed by pedagogical institutes and institutions formed within Ministries of Education. Teacher education, training and professional development are also covered by several programmes and projects carried out by the international community and by local and international non-governmental organizations. (Pašalić-Kreso, Muratović, Rangelov-Jusović & Trbić 2006).

1.2.3 Current Educational Reform of Primary School

Currently in BiH, there is an international reform effort targeting the educational system, within all levels of the Government (municipal, cantonal, entity and State). The *Education Reform: A Message to the People of Bosnia and Herzegovina* (2002) is a comprehensive document listing the goals of education reform and focusing on the action needed to realize these goals. This document contains the following five Pledges:

- Pledge 1: access to quality education for all children free of discrimination in integrated schools which respects the rights of the children;

- Pledge 2: good quality of basic education with modern curriculum, system of assessment and certification for pupils and teachers;
- Pledge 3: development of vocational education and training systems;
- Pledge 4: quality of higher education;
- Pledge 5: Financial investment and legislation in education.

As a part of the educational reform strategy, BiH authorities adopted several documents. Key documents for this study are those which focus on lower grades in primary education within (1) the territory of the Federation of BiH and (2) the Canton Sarajevo.

The Nine Year Education Concept. One of the documents which relates to the education reform strategy is the *Concept of Nine-Year Primary Education* (2004). Children and their interests and needs are in the centre of this new Concept. In that sense, the Concept predicts changes with special attention to the following: (a) individualization and engagement of child, (b) relation between teacher and pupil, (c) contemporary and innovative teaching methods, (d) atmosphere in the classroom, (e) institutional and system changes, (f) curriculum change and (g) inclusion of parents. This document also underlined that teachers are the main agents of change and the speed at which change will occur in the society depends on them.

Laws. Changes predicted by the educational reform strategies and by the presented Concept above are also woven in two Laws which are significant for this study. These laws are State-level and Cantonal-level laws on primary education. Authorities have adopted a *Framework Law on Primary and Secondary Education in BiH* (FL 2003). According to this Law all of the lower-level legislation on primary and secondary education in the Cantons, the RS and the Brčko District have been brought in compliance with this FL (2003, Art. 59). Therefore, the Assembly of the Canton Sarajevo at 22 April 2004 adapted the *Law on Primary Education of Canton Sarajevo* (LP 2004). This legislation has established the following aspects:

- Every child has a right to access and equal participation in the educational process as a basic principle of educational and human rights (FL, Art. 1, 3, 4, 5, 6 & 36);
- Education has quality as its basic and overall aim (FL, Art. 3);

- Pupils should attend schools in their own communities (FL, Art. 12; LP, Art. 19);
- Child's interests and needs should be in the focus (FL, Art. 2, 3, 4, 34 & 36);
- Primary education is obligatory and free for all children (FL, Art. 12 & 16; LP, Art 3 & 44);
- Schools should be non-selective for all children, regardless of their abilities; including children with special needs (FL, Art. 3, 8, 9, 10 & 35; LP, Art. 7, 8 & 20);
- Children and youth with special needs will be educated in regular schools and in accordance with their individual needs (FL, Art. 19; LP, Art. 26, 27, 28, 46 & 47);
- Pupils' educational development and progress should be regularly assessed and graded, in order to ensure that they acquire an education suitable to their needs and possibilities (FL, Art. 34; LP, Art. 54, 55, 56, 57, 60 & 63);
- Teachers have certain level of freedom and autonomy with conducting their teaching methods in the ways they believe are adequate, taking care about standards and the sustainability of the existing methods and application of the new methods in the educational process (FL, Art. 41; LP, Art. 43);
- Parents, care takers and foster parents exercise their rights and obligations to: take care of the education of their children, ensure regular attendance of their children at school, and to be informed, consult and follow the educational progress of their children (FL, Art. from 22 to 28; LP, Art. 44, 57, 66, 70 & 100).

1.2.4 The Slow Process of Changes

The need for changes and reform efforts in the educational sector is very big, although this process and implementation of new legislation is progressing at a slow pace. A number of limiting conditions still exist and present an international problem, such as a long period of isolation, post-war recovery and traditional attitudes (Dzemidzic 2007; Pavlovic 2005; Smajic 2004; Varunek 2006; Zekic 2004).

Even though legislation ensures free education, the real situation in practice is arguable. Primary education is not completely free and parents must pay for many things at school: textbooks, handbooks, notebooks, school supplies, transport etc. In a country such as BiH, with a large percentage of unemployed citizens (43, 9 %, data from 2006,

Centre for Promotion of Civic Society 2007), the myth about free and equal education is ruined (Jović 2006).

The schooling has retained some past practices from the older traditional system which existed before the introduction of the educational reform. Thus, education is still more focused on teaching content and it is more teacher-centred, rather than pupil-centred. Whole class approach is still the dominant form of classroom organization. The situation of accumulation of knowledge through memorizing facts where pupils are just objects of education is the main characteristic of the traditional BiH schools (Varunek 2006). These characteristics, as well as the traditional organisation of the lesson in each subject within 45 minutes, cannot ensure a pupil-centred education, neither appropriate teaching-learning environment. Unfortunately, the majority of teachers are reluctant to change and in most cases they do not consider themselves competent enough for modifications and adaptations of the curriculum according to the pupil's needs. Reasons for slow changes may also be the low income of the teachers in public primary schools, as well as insufficient respect of teacher's occupation, lack of teachers' motivation to improve the existing practice, lack of training in modern pedagogical methods and in the principles of inclusion.

A number of reports have been published covering the topic of education in BiH which show the difficulties concerning implementation of the reform. These reports cover issues as the position and the rights of children, and show that: 7 % of children are not included in primary education (OSCE Mission to BiH 2008); classrooms are not suitable for the new curricula (Helsinki Committee for Human Rights in BiH 2005); rare examples of schools hiring professionals to work with the children for the purpose of individualizing curricula (Ombudsman Institution of the Federation of BiH 2005); discrimination against persons with disabilities (United States Department of State, Bureau of Democracy, Human Rights and Labour 2005), etc.

1.3 Rationale of the Study

Leaving a traditional system where teachers and content are in the centre and pupils are the objects, and turning towards an individually-adapted and pupil-centred educational perspective is not an easy process. It is being conducted at a very slow pace, as shown by reports mentioned above. Today, the important question is: 'Who is going to do that?' (Bauman 2001, p. 111). The crucial influence on pupils' learning and development comes from teachers, and thus they have an important role and obligation in the process of change. In the situation of BiH with intentions for changes, but with a deeply ingrained traditional system, teachers have a significant role in contributing to the improvement of the current situation by listening to the actual needs of the children, and by creating a teaching process in which pupils and their needs are emphasized.

The principle of equal quality education where individually adapted education is essential has been established by BiH legislation. These principles create a new situation for all participants in the teaching-learning of mathematics, especially for teachers. Thus, the purpose of this study is to contribute to an in-depth knowledge and understanding of the phenomenon of teaching and learning with special focus on individually adapted education according to the diversity of pupils within mathematics classes. The phenomenon of teaching and learning with special focus on individually adapted education according to the diversity of pupils within mathematics classes required an attempt to answer the following questions:

1. How does the teacher manage to teach mathematics to all pupils with their different educational needs in a third grade primary school?
2. Which challenges does the teacher meet in this process, and how does the teacher confront these challenges?

These questions were investigated through a single case study applying a combination of observations of mathematical lessons, interviews with the class teacher, and analysis of texts and materials. Results and findings are assumed to contribute to further knowledge related to the theory and studies presented in the next chapter.

CHAPTER 2: Review of Related Literature

Introduction

As stated by the research question, the study is focused on the teaching of mathematics in relation to meaningful individual learning for all pupils in a class. Chapter 2 presents a review of the literature which includes some theoretical aspects and previous studies about teaching and learning mathematics. These theories and previous studies are presented through a Curriculum Relation Model (CRM) developed by Johnsen. The CRM consists of eight main aspects in the teaching and learning process which inspired the investigator to use them for further systematically focusing on the phenomenon of teaching and learning mathematics according to the diversity of the pupils.

2.1 The Curriculum Relation Model

The CRM is developed by Johnsen (2001, 2003 & 2007) and presented in three publications as a working tool for teachers and special needs educators. The first 2001 publication focuses on the inclusive class and school, while the edition 2003 focuses on assessment and the last edition 2007 represents an application of the model in the BiH. Nonetheless, all of them present aspects related to the individual adaptation of education according to the diversity of the pupils. According to Johnsen (2001& 2003) the CRM can be applied: (a) as a guide to an overview of central aspects of teaching and learning, (b) to support awareness of the continuous interrelation between these aspects, (c) as a guide to asking questions, discovering sub-aspects, gathering relevant knowledge and training teaching skills within and between aspects, (d) as a guide to long-term and short-term planning and (e) as a frame for systematic planning, implementation and evaluation of the teaching-learning process.

The CRM consists of the following 8 main arenas (Appendix 6): (1) the pupil(s), (2) frame factors, (3) intentions, (4) content, (5) strategies, methods and organisation, (6) assessment/evaluation, (7) communication and (8) care. Each arena consist examples of

sub-arenas. [7] In the following sections the theories and previous studies in mathematics education are presented in relation to these eight aspects. The teaching-learning of mathematics is a complex process and presented arenas should not be viewed strictly as separate or in some established order, but rather as interrelated.

2.1.1 Pupil(s)

Pupils and their diversity of educational needs are in the centre of the CRM, versus discipline-centred orientations. According to Johnsen (2001& 2003) a major professional educational understanding of pupils concerns knowledge about pupils' learning and development. This issue is presented through Vygotsky's theory of cognitive development.

Vygotsky's Theory of Cognitive Development. Vygotsky (1978) considered that the child's cognitive development is determined by two developmental levels: actual developmental level and the zone of proximal development. Actual developmental level represents an already completed developmental cycle which contains what the child is able to do alone, i.e. what s/he has already mastered and achieved. According to Vygotsky (1978) the zone of proximal development represents the distance between the actual and potential level, between what an individual child is able to do alone and what s/he can achieve 'through problem solving under adult guidance or in collaboration with more capable peers' (Vygotsky 1978, p. 86). Therefore, learning development is the result of interaction between the child and his/her environment. The environment in school perspective represents teachers and peers in class and in play. As it may be seen from Vygotsky's theory, a prerequisite to teach pupils mathematics is first to determine their actual levels. Johnsen (2001& 2003) raises the question of how we get to know the pupil and gives an answer related to assessment or evaluation.

2.1.2 Assessment

Assessment and evaluation may have different meaning. In accordance with the BiH dictionary *Terminology for Educators* (Hrasnica, Babić & Topić 2005) assessment is

[7] Main arenas and sub-arenas of the CRM are described with examples in publications from 2001 and 2007.

the method used to establish the level of pupils' development, while evaluation is the procedure of grading. Thus, grading and evaluation of pupils is only one small part of assessment (Bigge et al. 1999; Johnsen 2003).

Westwood (2004) emphasised four functions of assessment: (1) checking effect of teaching programmes, (2) determining pupils' development stages, (3) gaining information about pupils' specific instructional needs and (4) identifying concepts and procedures which may need to be re-taught or reviewed. Bigge et al. (1999) also stressed four purposes of assessment, but the authors have more focus on the assessment of plans and programmes. These are: (1) to develop initial individual education plans, (2) to review the plans, (3) to assess the instruction, and (4) to assess the program.

When assessing pupils, there is need for a holistic understanding of the pupils that includes a contextual and ecological assessment (Bigge et al. 1999; Johnson 2003). Ecological assessment is defined by Overton 1996 (in Bigge et al. 1999) as the assessment of all pupils' environment. The importance of environment is emphasized also in ecological perspective of Bronfenbrenner (1979). It is presented as a group of settings or as Russian nesting dolls in which human beings develop through interaction (Rogoff 2003). There are four settings (Bronfenbrenner 1979; Rogoff 2003; Miller 1993): (a) microsystem (the pupil's experience in school in contact with peers and teachers), (b) mesosystem (the relationship between school and home; parents' help in completing of the pupils' homework), (c) exosystems (pupil isn't included directly but events in other systems affect her/him) and (d) macrosystems (the influence of culture or sub-culture; attitudes about mathematics).

Table 1: Examples of Assessments by Three Authors

Johnsen	Ornstein	Westwood
Observation	Observation	Observation
Achievement test	Testing	Tests
Pupils works	Homework	Pupils written works
Dialogue with pupils	Notebooks and note taking	Error analysis
Interviews and conversations	Class discussions and recitations	Interviews
Portfolios	Pupils portfolios	Questioning
Checklists	Self-judgment	Checklists
Logbook or diary	Group evaluation activities	Diagnostic testing
Screening tests	Peer assessment	
Assessment as part of mediating	Quizzes	
Specific mastery or ability tests		

Literature presents a variety of methods for assessment. Table 1 above presents examples of assessments of class, group and individual by three authors: Johnsen (2001, 2003 & 2007), Ornstein (1995) and Westwood (2004).

Although the teachers are the ones who conduct assessment; it is also used by pupils and their parents in making decisions about future education (Salmon 1996). According to Stiggins 1993 (in Salmon 1996) pupils use results of assessment to make decisions about themselves, i.e. to establish their own personal academic expectations, decide whether to put forth what to learn, with whom to learn and when to study, as well as formulate their relationships to school and schooling.

Assessment is also an important issue in mathematics. Thus, qualitative research by Salmon (1996) about mathematics assessment with six regular and special educational teachers showed some of the following results:

- Most teachers made decisions about assessments in their classroom based on the grade national curriculum;
- Pre-assessment allowed teachers to see if pupils had prior knowledge and according to that knowledge, they made decisions about instructions;
- Pre-assessment allowed pupils to see where they may need extra help;
- Teachers were guided in what to teach by state curriculum and spent their time deciding how to teach and assess.

According to presented aspects, the information gathered from assessment is used by teachers to learn about their pupils, assess their own work and to make further decisions. One of those decisions is related to educational intentions.

2.1.3 Intentions

Educational intentions are described through aims, gaols and objectives. Here, they are presented through Ornstein's (1995) view. Translating the needs of society into educational level, aims are presented broad statements created by national level through legislation and policy documents. Aims are translated into goals across subjects and grade levels and represent the school program. Goals are written by professionals and

published as curriculum guidelines. Both aims and goals are descriptive, while objectives are observable and measurable. Objectives take place at the classroom level and they bring teachers' and pupils' focuses on what should be taught. Objectives are further divided into units and lesson plans and are written directly by the teachers.

Johnsen (2001 & 2003) and Noddings (2003) stress the need to widen the perspective of intentions so that they are also adapted to the pupils' needs, interests and possibilities. Thus, Noddings (2003) argues for possible conflicts between aims stated by society and by individuals. She also raises the question whether each lesson should have a specific learning objective or if it is possible that they give instruction to teachers what to do and 'leave open what the students might learn' (Noddings 2003, p. 78). Johnsen (2001) proposes operationalization and adaptation of goals and objectives to 'concrete educational actions within the framework of existing policy' (Johnsen 2001, p. 269). According to Taba (1962) the most important function of educational objectives is to provide guidance for decisions about selection of contents.

2.1.4 Content

Educational content may be understood in different ways. It can be seen as syllabus prescribed by authorities as part of curriculum. The content in national curricula can be posted more generally and thus ensure flexibility to teachers in making decisions or it can prescribe detailed directions (Johnsen 2001). When content is understood as syllabus they may be seen more as frame factor and in that case the teachers' duty is to make bridges between official curricula and the situation in their class. Content also may be understood as school subject, textbook, teaching topics, units and lessons, as well as materials and learning environment (Johnsen 2007).

Content influence decisions about teaching strategies and in that sense it is connected with other arenas of the CRM. Bigge et al. (1999) present the content of mathematical standards developed by National Council of Teachers of Mathematics (NCTM). One of them concerns mathematical connections. Bigge et al. (1999) referred to mathematics in connection with daily life and with other disciplines, as well as in connection with mathematical topics. Similarly, the NCTM (2008) emphasized that pupils should

experience the interplay among mathematical topics and between mathematics and other subjects, as well as connect mathematics concepts to their daily life with the intention to see that mathematics 'is not a set of isolated skills" and to "recognize how ideas in different areas are related' (NCTM 2008). These statements underline the importance of meaningful learning of mathematics. Nicol and Crespo (2005) in their article stressed questions of what counts as meaningful contexts for learning mathematics. They discussed the studies which have reported possible answers to this issue. These are: focus on the students' informal mathematical activity, use of out-of-school activities, authentic experiences with mathematics and use of subject areas (e.g. science or literature) as contexts for teaching-learning mathematics.

2.1.5 Teaching Strategies

Teaching strategies are defined as the procedure to attain a goal (Lipovac & Vukobratović 2002; Ostad 2001). However, as it has been mentioned, teaching cannot be resolved and formulated without addressing the relation between learning and development of pupils. Thus, Vygotsky's theory of cognitive development clearly stressed the importance of learning through guided participation by teacher and peers. Johnsen (2001) presented four main aspects of teaching strategies: (1) teaching methods, (2) classroom organizations, (3) teaching materials, and (4) peer support.

Table 2 presents some forms of teaching methods by four authors: Bognar and Matijević (1993), Brammer 1838 (in Johnson 2001), Poljak (1984) and Slatina (1998).

Table 2: Teaching Methods by Four Authors

Bognar and Matijević	Brammer	Poljak	Slatina
- Problem teaching method - Heuristic method - Programming method - Learning by discovering	- Prescribing method - Achromatic method - Dialogic method - Heuristic method	- Demonstration method - Practical work method - Illustration method - Writing method - Dialog method - Working on text method - Lecturing method	- Lecturing method - Teaching dialog and discussion method - Textual communication method - Writing method

The teaching strategies in this part are further presented through some aspects which are met in teaching strategies. Those are: effective teaching, differentiation, scaffolding concept, play, peer support, classroom organization and teaching materials.

Effective teaching. A study within the project named Effective Teachers of Numeracy showed that effectiveness of pupils' acquisition in mathematics was determine by the use of teaching methods (Askew 2000 & 2001). The study showed that teachers who used connections orientation were highly effective. This orientation is based on connection between different aspects of mathematics (connections of contents), between different representations (symbols, objects and words) and connection with pupils' learning strategies. The responsibility of the teachers is underlined in relation to the pupils' efficiency and effectiveness through using appropriate methods based on dialogue between teacher and pupils. Effective teaching was related to teachers who didn't have strong orientation, while transmission and discovery orientations were moderately effective. Transmission orientation is directed on clear explanations of procedures or routines which entails on papers and pencil methods, reinforcement of the 'correct' method and more practice to help pupils to remember. Discovery orientation requires use of practical experiences which ensure pupils discover ideas for themselves.

Westwood (2004) suggests several interrelated effective instructions approaches by several authors. Table 3 presents three of them:

Table 3: Effective Instructions Presented by Westwood

Alexander	Lilbrun and Rewson	OFSTED[8]
- Direct teaching - Enquiry that challenges pupils - Scaffolding	Teaching based on: real situations, pupils' experiences pupils' interests, use variety of different materials, involving pupils in activity, flexible classroom organization, listening of pupils, pupils' encouragement to take risks and to learn from their errors	Teaching based on: well planed work, balance of classroom organizations, engagement of pupils in talking about mathematics, clearly defined task, application of mathematics on real-life problems, connection with other subjects, clear analysis of errors and correction of them, use of printed and practical materials

Suggested methods for effectiveness refer to a variety of teaching used in a classroom. However, Westwood (2004) emphasized that there is no shortage of information about the types of teaching that will show the connection with good pupils' attainment. Westwood (2004) gives the example of The Britain Office for Standard in Education from 1993 which reported results of observation across 128 primary schools. The results showed that the best standards were in classes where teachers used a variety of teaching methods. Similarly, Wormnæs (2006) underlined teachers' competence and flexibility

[8] OFSTED is abbreviation for the Office for Standards in Education in Britain.

in ensuring quality education, as well as teachers' knowledge about the variety of learning ways which pupils use. In this respect, she recommended a combination of direct instruction, mediated experience and independent studies as teaching styles that can reach out to pupils with diverse learning styles.

Differentiation. Varity of teaching is also recognized in a differentiation approach to learning. The aim of differentiation is to meet the diversity of pupils' educational needs by applying a variety of instructions (Ivory 2007; Norwich 1994; Tomlinson 1995; Westwood 2004). Tomlinson (1995) stressed that differentiated instruction is not the individualized instruction, it is not losing control of student behaviour and just another way to provide homogeneous grouping, it is not giving same exercises or tasks to most pupils and different to pupils who showed difficulties. The author further explained that there is no recipe for differentiation and that teachers conduct varying ways of differentiation based on their own personalities, the nature of the subject, grade level they teach, and the learning profiles of their pupils. However, teachers, making decision about differentiation, have in mind the diversity of pupils and they believe that effective instruction is based on pupils' active participation in decision making and problem solving.

Scaffolding. The scaffolding concept is derived from Vygotsky's theory and described for the first time by Wood, Bruner and Ross 1976 (Lindén 2003). The concept of scaffolding is used in education literature as metaphor for support (Anghileri 2006; Greenfield 1984; Holton & Clarke 2006). Anghileri (2006) gave examples of alternative scaffolding strategies from studies relating to arithmetic teaching for pupils at the age of 9-13 and with the purpose of identify classroom interaction that can be effective for learning of mathematics. Holton and Clarke (2006) also presented key elements of scaffolding in mathematics through examples drawn from many different researches. They saw scaffolding as a way that leads pupils to meta-cognition and they present three types of scaffolding:

- Expert scaffolding – involves someone with specific responsibility for others learning. It can be a teacher or more capable peers;

- Reciprocal scaffolding – involves two or more persons who bring different skills in common work or task and each of them may provide a contribution. In particular situations one of them can take the role of the expert, but the role of expert may be exchanged;
- Self-scaffolding – presents an individual who is able to provide scaffolding for her/him self based on previous knowledge or intuition.

Both articles emphasized teaching-learning activities based on support and guidance through scaffolding questions.

Play/game[9]**.** While engaged in play, pupils solve simple and complex problems. Bognar and Matijević (1993) emphasized that games have an important place in teaching when they are directed towards learning of some content. Role-play, plan-play and rule-play are citied by these authors as forms of simulations. Simulations are used when involvement in real situation are not possible or when pupils are prepared for real situations. According to the same authors these games may be used for the purpose of learning, but they also present a rich experience and full engagement in activity.

Peer support. In school, pupils at the same age are grouped together in class. Classmates work on the same lesson, they play together and they are engaged in the same activities at school and in neighbourhood. Through these interactive situations they learn and develop. This is in direct connection to Vygotsky's view on child's development. In cooperative activities, the pupils themselves often become teachers of each other in guided participation and shared understanding in routine problem solving activities (Rogoff 1990). Thus, the findings from Dzemidzic's study (2007) showed that cooperative learning enables the creation of an efficient teaching and learning process based on the support and mediation of classmates. The group work is one of the possible forms of organization of teaching-learning process which can provide interaction between pupils. Forsyth (1999, p. 5) defined the group as 'two or more interdependent individuals who influence one another through social interaction'.

[9] Even that some authors (for example Cole, Cole & Lightfoot 2005) make distinctions between play and game, and by some authors (for example Fein 1992) game is citied as a form of play. Here play and game are presented as synonyms.

Dunne and Bennett 1990 (in Alexander 2000) identified three types of group work in primary classrooms:

- group members work on the same task sharing ideas while doing;
- each group member works on a specific aspect of a single task, producing different outcomes;
- group members work together on a single task to produce a single outcome.

While working in a small group, the pupils also cooperate instead of compete, treat each other as resources, like school, develop self-esteem, perform better and see their classmates as learning resources (Aronson et al. 1978). Implementing peer interactions in the mathematics class could be one way of dealing with the mastering or overcoming difficulties which pupils may have in this subject. Westwood (2004) proposed some advantages of peers' assistance in an arithmetic classroom situation:

- It can be less threatening to the pupil being helped than if the teacher singles her/him out for extra attention in class,
- Peer may be able to see subject matter more easily from learner's viewpoint,
- Peer may be able to explain in language more easily understood by the learner and to use examples to which the learner can relate,
- The learner may be more willing to say to the peer than to teacher that s/he doesn't understand and needs to be shown something again.

Mutual interactions between peers are also very important not only for their academic knowledge, but also for their participation in school and daily activities.

Classroom organization. There have been identified three forms of classroom organization: whole class approach, grouping and individual work. Bognar and Matijević (1993) stressed the importance of a balance in implementation of classroom organization in order to meet the needs of pupils for individualization and socialization. The authors suggested the differentiation of the tasks for the individual work, the tasks for the groups and the activity for work in pairs. However, they also underlined the needs for the exchange of activity in which teacher works with the whole class and

when the pupils work independently (either in groups or individually). On the contrary, the already presented study within project Effective Teachers of Numeracy, showed that the classroom organization didn't determine effectiveness of pupils' acquisition in mathematics (Askew 2000 & 2001).

Teaching materials. Teaching of mathematics includes helping pupils move from concrete to abstract thinking. Pupils need hands-on activities which include direct experience with materials and visual methods, representing materials and symbolic representation (Liebeck 1984 & 1995; Westwood 2004). In this perspective, the teachers' role is to make and use different teaching materials. Teaching materials are also named media by Bognar and Matijević (1993). A survey study realised by Marlow and Inman (1997) reported that 60 % of teachers of 1 to 6 grades in mathematics used textbooks as teaching materials. In addition, teachers infrequently used calculators, geometrics' models, fraction rods and tangrams[10], as well as mathematical journals and video tapes. The study also identified four barriers to instructions: the lack of appropriate teaching materials, the low parental expectations, the management and discipline problems, and planning and preparation requirements. The action study with fifth grades by Lett (2007) showed that manipulative material might have an impact on pupils' achievement in mathematics. In this study pupils showed more interest and enjoyed the lesson, they had the ability to construct their own knowledge and develop a fundamental understanding.

2.1.6 Communication and Care

Although teaching and learning are the most important tasks of schooling based on knowledge, 'communication and care represent an extended view of education' (Johnsen 2001, p. 288). Cooperation and communication in a friendly environment, in effective socio – emotional climate, with positive interaction between all participants make the basis for teaching-learning processes, because these conditions create the foundation for mental development (Rye 2001). Rye (2001 & 2005) presented 8 themes of the International Child Development Project (ICDP) which formulated quality

[10] Tangram consists of seven geometrics pieces, which fit together to form a shape of some sort.

interaction, communication and mediation. The following themes from ICPD were applied to interaction between pupils and teacher:

- The demonstration of the positive feeling (interest, responsibility, love, care...)
- The adaptation to the pupils (pupils' interest and needs)
- Talking to the pupils (inviting pupils to take part in dialogues)
- Giving prise and acknowledgment
- Helping the pupils focus their attention
- Giving meaning to the pupils' experiences
- Elaborating and explaining
- Helping the pupils achieve self-discipline (Pavlovic 2005; Rye 2001 & 2005).

Positive interaction is possible to be applied in various ways. Thus, Pavlovic (2005), investigated manifestation of 8 themes from ICDP, referred to 266 variations of positive communication between teachers and pupils during 15 observed lessons. Positive socio-emotional climate, communication and interaction are also important in mathematics, especially because of appearance of fright of this subject (Gresham, Sloan & Vinson 1997; Schwarz 1999; Westwood 2004).

The issue of communication is directly tied with care. Noddings (2005) defined care as the relation and connection between carer and recipient of care, or in the school situation between teacher and pupils. Rye (2001& 2005) presented psychological experiences which have been met in an effective socio-emotional climate and positive interaction. Those are needs for being: seen-heard-noticed, met, understood, accepted, acknowledged, respected and loved. All of these are also expected from teacher who 'cares' for their pupils. However, the teachers have also the responsibility to help their pupils to develop the capacity of care for self and others, but also for: plants, animals, environment, objects, human-made world, and ideas (Noddings 2005).

2.1.7 Frame factors

Frame factors represent those factors which are not directly involved in the teaching-learning process of mathematics, but indirectly affect it. The teaching profession,

cooperation with parents and other educators and needs for change in frame factors are presented here as some of frame factors[11].

Teaching profession. The teachers' professional qualities may be seen as one of the main aspects of frame factors because of teachers' crucial influence on child's development and learning. Zečić and Jeina (2006) emphasized the need for in-service education as help to teachers in their continuous development of professional competences. The study within project Effective Teachers of Numeracy, found contrary to this apprehensions that levels of teachers qualification does not determine effectiveness of pupils acquirements in mathematics (Askew 2000 & 2001). A study by Radeka and Sorić (2006) showed that professional status of teachers is influenced by their happiness with work. This study which was carried out among 462 teachers in the Zadar County (Republic of Croatia), showed that the teachers even though they were happy with their profession and own competence for performing job, they were not happy with working conditions. Teachers were especially concerned with low living standards and the bad reputation of the teaching profession in the society. Thus, as much as a third of teachers would like to resign from their profession.

Cooperation with Parents. The main participants in the teaching-learning process are pupils and teacher. However, important roles in this process are also in the hands of parents and caregivers who have an influence on pupils' learning process. Varunek (2006) clearly stressed the importance of teachers' mediations in initiating positive communication between teachers and parents. There are also many publications which offer tips or suggestions for parents or teachers about this issue (e.g. brochures by Darby 1997; US Department of Education 2003; Stepanek 1998). One of the aspects in these publications is parental involvement in pupils' completion of homework. Studies by Balli (1997) have referred that parents' participation in pupils' homework can increase pupils' achievement in mathematics. Contrary to this, Bal and Goc (1999) found no improvement exhibited in mathematics after applying the program for increasing parental involvement to improve academic achievement of six grade pupils.

[11] Legislation and policy documents as Frame factors are already presented in Chapter 1.

Team work. Apart from class teachers, there are also other teachers presented at the school level. Teachers are organized as tandems and professional teams. In the BiH dictionary *Terminology for educators* (Hrasnica, Babić & Topić 2005) team work is defined as a collective work of more teachers on one close subject or related subjects, and it is based on the principle of tasks division. Bognar and Matijević (1993) emphasized the advantages of team work: team teaching is more wealthy, dynamic and diverse than teachers' independent work; in team work contents of different subjects are easier connected and there is better possibility for utilization of individual skills and ability of teachers. Through cooperation and team work all teachers exchange their own experiences, and by doing so, teaching could be improved by making it more interesting to the pupils and more pupil-focused (Johnen 2001). There are also special educators, as well as educational – psychological service teams, support centres and other professional persons. All participants involved in team work can help in making an appropriate curriculum which will be more children-centred and 'their common task is to adapt the learning environment to the needs and capabilities of each pupil in the class' (Johnsen 2001, p. 257).

Change in frame factors. The project named *the Classroom towards Inclusion,* conducted by Norwegian and Bosnian researchers and other educators, was organized as a series of workshops carried out in BiH (Johnsen 2007). During workshops, participants expressed their need for changing of the existing frame factors as presented below:

- Decrease the number of pupils in the class
- Financial support for materials and equipment
- Changing of the school interior
- Upgrading teachers
- Teacher training in coping with stress and burn-out
- Needs of special needs educators in the school
- Needs for internal teams and more cooperation with external support teams
- Needs for more cooperation between school and parents.

According to this review of literature, the teaching process should be adapted to the diversity of pupils and their different educational needs by comprehending a number of different aspects. As mentioned earlier, the main aspects/arenas and sub-arenas of the CRM in publications by Johnsen inspired the investigator to use them as categories for this study. Even though the main aspects/ arenas of the original CRM are more related to a general didactical aspect and not focused specifically on mathematics, they gave the investigator a background understanding of how it is possible to move further on systematically focusing and developing sub-arenas in more details. Therefore, in order to suit the context of the present study, the original CRM was modified and adapted. The modification of the CRM is presented in the next chapter which involves the methodology used in this study.

CHAPTER 3: Methodology

Introduction

Chapter 3 presents the methodology used to gain answers to the problem and questions under study. The first part of this chapter presents the research design and discusses its strength and limitations. The second part relates to the process of data collection and consists of: sampling procedure, gaining entry into the study, methods and instruments and ending procedure of data collection. The third part presents steps of analysis and embedded arenas of analysis. The chapter concludes with issues pertaining to ethical consideration. Validity problems and limitations issues are also taken into consideration, but they are not presented under separate headings.

3.1 Research Design

In order to answer the research questions relevant to this study, the investigator chose to use a qualitative approach based on a single case study. This approach allowed for an in-depth investigation of the phenomenon of teaching and learning processes with focus on individual adaptations according to the diversity of pupils in a natural context (Gall, Gall & Borg 2003) and from different angles. Thus, this phenomenon was studied both from an etic and emic perspective and through multiple sources of information that was gathered through observation, text and material analysis and interview. The etic perspective is defined as the investigator's viewpoint, while the emic perspective presents the participant's (teacher's) viewpoint of the phenomenon (Creswell 1998; Gall, Gall & Borg 2003). Different angles of the phenomenon were also investigated through embedded (multiple) units of analysis within a single case of the phenomenon being studied. Embedded units are specific aspects of the case (Creswell 1998; Yin 2003). Embedded units, used in this study, are the presented arenas of the CRM[12]. In order to suit the context of the present study, the original CRM was modified and

[12] Original Curriculum Relation Model has been presented in Chapter 2 of this study.

adapted twice: the first was during the process of data collection and the second was during data analysis. Modifications of Model are presented further in this Chapter.

The phenomenon represents an educational approach derived from BiH *Educational Reform* (2002). Though BiH may have similar studies that focus on one or more aspects, as well as on different subjects, but this was the first study in BiH focused on the field of mathematics. Therefore, the study may be said to be a case which was 'previously inaccessible to scientific investigation' (Yin 2003, p. 42). Here it is also important to point out that although individually adapted education to different educational needs of pupils is a relatively new approach ensured by law, it is still assumed that some teachers already have applied it in their teaching-learning practices.

The single case study used for this inquiry also had a limitation. Thus, non-standardized instruments and purposeful sampling with a focus on only one case doesn't allow for the generalization of findings and formulation of general statements. This was expected and hence the purpose for this study was to contribute to the theory with an in-depth knowledge without the intention to generalize findings on population (Gall, Gall & Borg 2003; Yin 2003). However, an issue of generalization in case study was questioned. Thus, Gall, Gall and Borg (2003, p. 466) gave the example of Sandra Wilson who stressed responsibility of readers 'to determine the applicability of the findings in their own situations'. Similarly, Robson (2002) internal generalizability refers to the setting being studied, while external generalizability referring to theoretical insights that 'possess a sufficient degree of generality or universality to allow their projection to other contexts or situations' (Sim 1998, in Robson 2002, p. 177).

3.2 Process of Data Collection

The process of data collection from the beginning of September to the end of December 2007 went in several steps (Appendix 7). The first steps involved sampling procedures and efforts to obtain permissions for the study.

3.2.1 Purposeful Sampling of the Primary School and the Teacher

The purposeful sampling procedure that was used is typical for qualitative research (Creswell 1998; Gall, Gall and Borg 2003& 2007; Patton 1990; Robson 2002). The purpose for using this sampling was to select a case that is 'information rich' (Patton 1990, p. 169). In order to get rich data and information about the phenomenon in focus, it was important to decide where to search and what informant to choose.

Selection of School. Among 64 ordinary primary schools in the Canton of Sarajevo (Ministry of Education and Science, Canton Sarajevo 2008) one primary school was purposefully selected for this study. Several projects focused on child-centred education were already applied in the selected school. Thus, this school had relevant trainings for teachers in the field of individual adapted education. One of these projects was carried out in the duration of about two years as part of a larger project entitled *Institutional Competence Building and Cooperation with two Bosnian Universities: Special Needs Education towards Inclusion,* financially supported by the Norwegian Cooperation Programme with South-East Europe 2002 – 2004 (SØE 06/02). One of the goals of this project was to develop through innovation, teaching approaches that support individually adapted learning and development in a classroom (Johnsen 2007). This school has been a target school for various studies (for example, this is the 4th Masters Study), and allowed for a favourable experience (Dzemidzic 2007). The selected school may therefore be classified as a good case school.

Selection of teacher and class. Teachers in the lower grades of primary schools were the focal point for this study because the strategy of educational reform was still an ongoing process and by the period of conducting this research it had reached the 4th grade. Another reason also lies in the investigator's 14 years of experiences within these grades.

As a variance of purposive sampling for the selection of a teacher and class as a case, intensity sampling was used. Intensity sampling refers to a case that is not typical, but not at the extreme (Patton, in Flick 2002; Patton 1990). The intention was to select a teacher and class that could provide rich information about the nature of teaching and learning with a focus on individually adapted education according to the diversity of

pupils in mathematics lessons. In order to get background information about teachers that worked in lower grades, the investigator analysed their personal files. Key informants, principal and pedagogue of the school were also contacted in the process of identification of a teacher. The third grade was chosen because the selected teacher taught in this class.

3.2.2 Gaining Entry into the Study

Gaining permissions into the study occurred at the same time as the purposeful sampling procedure. Permission was applied for and gained from: the Ministry of Education and Science (Appendix 8), the participating school (Appendix 9), the case teacher (Appendix 10) and parents of pupils who attended the class (Appendix 11). All Permissions were obtained according to the procedures presented in Figure 3:

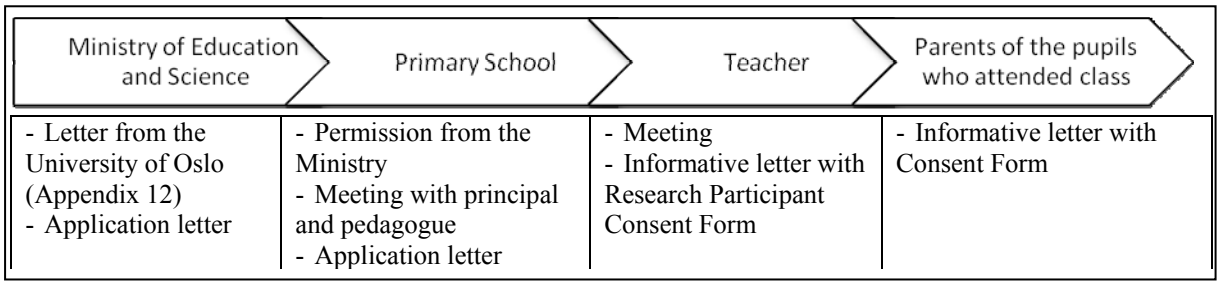


Figure 3: Procedures of Gaining Entrance in Study

3.2.3 Methods and Instruments

One of the main characteristics of the case study is the use of multiple sources of information (Creswell 1998; Gall, Gall & Borg 2003; Patton 1990; Robson 2002; Yin 2003). Multiple sources of information are used because no single source can be trusted in providing comprehensive information (Patton 1990). In that sense and with intentions to satisfy the principle of validity, this study used observation, interview and text and material analysis as research methods for data collection. The use of more than one method of data collection in literature is called triangulation (Creswell 1998; Gall, Gall & Borg 2003; Flick 2002; Kvele 1996; Patton 1990; Robson 2002; Yin 2003).

Observation

Direct, nonparticipant observation was conducted as an unobtrusive method in the data collection process. The intention was to gather data from an etic perspective about the

phenomenon. Observation entailed listening and watching what happened during the teaching and learning processes of mathematics (Robson 2002). Yin (2003) emphasized observation evidence as a useful issue in providing information about the topic being studied. In the nonparticipant observation conducted in this study, the investigator had the role of 'observer-as- participant'. Even though the investigator communicated with the teacher and the class, she didn't take part in the class activities nor the teaching-learning process of mathematics. This role of the investigator is also named observation – participant (Gall, Gall & Borg 2003). This presents observation where the observer enters a setting only to gather data (Ary, Jacobs & Razavieh 2002).

Before observations were conducted, the investigator visited the class twice with intentions to reduce reactivity and bias. Still, there was a possibility that the investigator influenced the teacher and the class activities through her own presence and use of video recordings.

The observation was organized in two steps. First, the unobtrusive observation approach was conducted in 5 days within two weeks in mathematical lesson for a duration of 44.30 – 67 minutes daily (depending on the duration of a single lesson, Appendix 13), with the intention of getting a better overview and a more holistic picture about the mathematical class and the teaching-learning process in which the study was conducted. Robson (2002, p. 311) suggested this approach for use in an exploratory phase 'to seek to find out what is going on in a situation as a precursor to subsequent testing out of the insights obtained'. Since a pilot-study wasn't conducted (which was one of the limitations of this study), these observations helped the investigator to refine the observation guide and to find a good position in the classroom for further video recording. Thus, the investigator there was trained on the job (Robson 2002).

After that, this study applied the second circle of observation approach which consisted of repetitive observations of mathematical lessons one day a week which was agreed upon earlier with the teacher. Six observations were conducted every Tuesday for the duration of 30 – 73 minutes (depending on the duration of a single lesson, Appendix 13). These observations occurred in a repeated process with interviews.

Observation instrument. The observations were structured by using a pre-prepared observation guide form and video recordings. The observation guide form was used as a basic checklist to allow the investigator to be certain that all relevant subtopics were covered. It was adapted and modified from the eight arenas the CRM mentioned previously, as well as according to the context of the actual sequence. Thus, there appeared one more arena named Other Topics where the observed elements that didn't belong to any other arenas were recorded. The observation guide form consisted of 9 arenas in its final form (Appendix 14). In addition, time and teaching lessons were also noted. The video recorded data (about 10 hours in total) was transcribed the same day into written format. Transcripts were summarized and analysed through an earlier developed tentative plan. The tentative plan consisted of the same arenas of the CRM as an observation guide.

Interview

Interview was also used as a research method in the data collection procedure together with the second circle of observations. The time between observation and interview enabled the investigator to have enough time for transcription, summarizing, and analysis of observed data and more time for the development of the interview guide. The purpose of including an interview was to attempt to understand the phenomenon of teaching and learning of mathematics from the teacher's point of view (emic perspective).

This study employed an in-depth, one-to-one semi-structured interview, which used open-form questions to obtain information. Open-ended questions allowed the investigator for an in-depth understanding, and to clear up misunderstanding from the conversation and encouraged cooperation (Robson 2002). However, using open-ended questions gave less control to the investigator than by simply using close-ended questions. A series of interviews were conducted about each arena[13] of studying phenomenon. The arenas were introduced to the teacher in the beginning, when the investigator introduced the aims, procedures and the course of research. Thus, the teacher had an overview of the topic of the interview. For the purpose of interviews,

[13] Arenas (8+1) of the modified Curriculum Relation Model.

some of the arenas were combined: Intention and Content for which was used in the same interview, as well as Communication and Care because the investigator found out that they consist of similar fields of interests.

The teacher was interviewed for a short period of time – approximately one hour. The day of the interview was earlier agreed with the teacher, one day in the same week while the observation was conducted (the observations and interviews occurred in a repeated process). A total of 6 interviews were conducted and in agreement with the teacher, it was conducted every Friday.

Interview instrument. The interviews were structured by voice recorded (with permission from the teacher) and using a prepared observation guide form (Appendix 15). In addition interview notes were conducted in case of technical voice recording problems which occurred on one occasion, therefore this interview was not recorded. In order to compensate this weakness, the investigator filled in all of the information immediately after the interview. The investigator also gave the notes to the teacher to read it, so she could clarify or add if something was missing or misunderstood. Some of the observed situations were repeated and made it possible for the investigator to ask some questions in later interviews.

The teacher was interviewed about what the investigator observed in the class during mathematical lessons. Thus, observations were the foundation for construction of the semi-structured interview guide. The process used to develop an interview guide from observation is shown in Table 4.

Table 4: Developing an Interview Guide from Observation

02. October 2007. Tuesday. First shift. 3rd lesson, from 9:40 a.m. Addition and subtraction of two digit numbers without carrying or borrowing.			
Minute	**Transcript**	**Observation**	**Questions**
0	Pupils sitting in the circle at the back of the classroom on the pillows on the carpet. The teacher is also with them...	Organization – all class approach	Why teacher organize beginning of lessons on this way?
...	...		
3	D1:"...my mother helped me to finish my homework!"	Frame factors – parents	How do parents help in doing homework? What is the role of parents in homework?

The voice recorded interviews were transcribed the same day to written format. After each session, the data collected during the interview was summarized and lightly analysed through an earlier developed tentative plan. This plan contained the arenas of the modified CRM previously mentioned.

Text and material analyisis

Text and material analysis was also used as a research method. This method was the basic source about background information, activities and processes 'that may not be directly observable and about which the investigator might not ask appropriate questions' (Patton 1990, p. 245). During the data collection, a number of written texts and materials appeared which were amounted to give important additional information about the phenomenon in study. Those are following:

- Documents and records[14] obtained by the teacher: pupils' files, textbooks and handbooks used for preparation of lessons, written preparation for lesson, curricula...
- Texts collected during lessons: teaching sheets, tests etc.
- Other materials /objects: wood and plastic products, toys, games etc.

Documents and records obtained by the teacher were analysed during data collection in fieldwork. Texts and other materials (objects) were photocopied, scanned or photographed and later described.

3.2.4 Ending Procedure of Data Collection

At the end of collected data the investigator organized special interviews with the teacher for about six hours, with the intention to secure validity. The teacher read the summary of observations and interviews and was asked to clarify or add if something was missing or unclear. She also listened and watched certain segments of the voice and video recorded materials. In order to get more valid data, this procedure didn't occur after each observation and interview because the investigator tried not to influence the teacher and teaching-learning process. Interview was occurred for about six hours (with

[14] Documents present written communication that is prepared for personal use, while records present written communication which has official purpose (Lincoln and Guba in Gall, Gall & Borg 2003).

short breaks).Even though this last interview was in a good atmosphere, it was maybe too long and presents one of the weaknesses of this study.

3.3 Analysis

The collected data from the different multiple sources of information have been analysed qualitatively. Analysis started during the field work while data collection was still in progress. As mentioned, data was transcribed and summarised through an earlier developed tentative plan. However, the organizing of the large body of information began after the investigator compiled all data (Gall, Gall & Borg 2003; Patton 1990). In order to reduce data and get insights about the phenomenon being studied, analysis occurred in the following steps:

1. Coding of data on observed sheets (Table 4; 3rd and 4th columns)

2. Sorting of observed information – The investigator made separate lists which covered all main arenas of modified CRM as units of analysis. In each list the investigator was wrote observed sequences. However, data still were broad and none organized in this phase. Sorted information in separate arena showed some common characteristic and similar contexts. Thus, the investigator had opportunity to synthesized data and start with developing of sub-arenas and making link between gotten information within separate arena. Repeated and similar situations were not noted, but only representative.

3. Coding of interviewed sheets – Information from numerous transcribed sheets were first coded. Certain important sequences of information from the interview were coded according to arenas of modified CRM similar as observed sheets.

4. Sorting interviewed information – The investigator on separate lists wrote important sequences in form of quotations of teacher's statements. Reducing of information was made similar as sorting of observed information.

5. Analysis of texts and materials – Data was fist separated into three main categories: a) documents and records obtained by teacher b) texts, and c) other materials /objects. Data was described and interpretative analysed.

6. Composing of information from multiple sources (Appendix 16)

7. Presentation and description of findings (Chapter 4)

Coding, sorting, analysis, and composing of data were made through embedded arenas of the modified CRM. However, the CRM was modified one more time for purpose of presentation of the findings.

3.4 Embedded Arenas of Presentation

As mentioned, in the period of data collection the original CRM (Johnson 2001, 2003 & 2007) was extended with one more arena named Other Topics. However, the Model was also modified during the data analysis. The investigator's opinion was that some arenas should be presented differently. Thus, for the purpose of presenting the findings the following changes were made:

- Since pupils and their individual educational needs was the centre of interest, the arena named Pupil(s) was not presented separately. However, there was the assumption that pupils and their individual education needs have been tied in each separately presented arena.
- Teaching strategies were presented in four separate arenas because of their complexity. Those are: teaching methods, classroom organizations, teaching materials and peer support.
- The arenas Communication and Care were consolidated because the investigator found that they consisted of similar field of interests.
- The arena named Other Topics appeared in the data collection stage. Even that some of the findings could belong to other presented arenas, the investigator opinion was that observed situations, findings and teacher's views presented different aspects and it was the reason for separately presentation of them.
- The answers to the second question were presented through 2 sub-arenas: Dilemmas and possible solutions and Problems and how they were confronted. Those two sub-arenas arose from the analysed interview instrument through the modified CRM. While

Problems and how they were confronted presents sub-arena of Frame factors, Dilemmas and possible solutions is sub-arena of all other main arenas.

Thus, the final form of the modified CRM used for this study presented the following arenas (Appendix 17): (1) Frame factors; (2) Assessment; (3) Intention; (4) Content; (5) Teacher methods; (6) Classroom Organization; (7) Teaching materials; (8) Peer support; (9) Communication and Care; (10) Other topics.

Each of the presented arenas further contained sub-arenas, except the arena named Peer support which is holistically presented. It is important to emphasize that even if the findings were presented in separate arenas and sub-arenas, all of them have been interrelated and should not be strictly separated. In order to maintain interrelations between the arenas, some sub-arenas in the Chapter 4 of this thesis were described and presented from different angles. For example, play was presented as a part of several sub-arenas: assessment, content, teaching method, classroom organization, teaching materials (medium).

3.5 Ethical Considerations

Because the research was conducted in a primary school as an institution, the investigator had to follow ethical procedures (Gall, Gall & Borg 2003 & 2007). Here are some of them:

- Permission was applied and gained from the: the Ministry of Education and Science (Appendix 8), the participating School (Appendix 9), from the case teacher (Appendix 10) and parents of pupils who attended class (Appendix 11).

- Introduction letters together with the Parent Consent Form for parents were sent by pupils because the teacher already had a parents –teacher meeting two days before the investigator met the teacher. Parents were informed that the study includes observations and video recording of their children and about the need for their consent. One of the parents phoned the investigator and asked for more information. He thought that the video recording would occur outside of the classroom setting.

- The teacher was informed about the plan of using a video camera for recoding class during mathematical lessons and the voice recording of interviews, as well as about privacy, confidentiality and voluntarily participation.

- Consent forms from the teacher and all parents were signed and returned to the investigator.

- All the data obtained during data collection were treated with confidentiality.

- In order to secure the School's, the teacher's and the pupils' privacy and anonymity, their names have not been used in this study (only pseudo names). However, there is still a risk because the teacher and her class may be recognized by colleagues and administrators in the participating School.

- According to ethical issues, the investigator was offered to participating school a written report and presentation of study on a school meeting and after the study.

CHAPTER 4: Presentation of Findings

Introduction

Chapter 4 presents the analysis of data collected through multiple sources of information. It is organized in two main parts according to the two research questions. Findings as answers to the questions are presented through 10 embedded arenas of the modified CRM. Qualitative in-depth descriptions of each sub-arena come after an overview of aspects about each arena in form of tables.

4.1 Teaching and Learning Mathematics According to the Diversity of Pupils

The first research question was: How does the teacher manage to teach mathematics to all pupils with different educational needs in the third grade of primary school? In order to answer this question, data collected from observations, interviews and texts and materials analysis are presented through embedded arenas of the modified CRM[15] as mentioned earlier. Each of the arenas contained sub-arenas[16], except for the arena named Peer support which is holistically presented. At the end of each arena, a summary of the findings within the arena are pursued.

4.1.1 Frame Factors

The factors reported here are: background information about the teacher and the class in which the teacher taught, information about the classroom and how it's equipped with materials, team work with other teacher and parents and the time table (Table 5). Though those factors are not directly involved in the teaching and learning process of mathematics, they are presented here first because they give some background information about the case being studied.

[15] Modification of the CRM is presented in Chapter 3.
[16] Appendix 17

Table 5: Overview of Aspects Regarding Frame Factors

	Teacher	Class	Classroom	Parents	Time table
Observed and analyzed files	• 20 years experienced • 4 years of University degree • Trainer • Advanced trainings	• 21 pupils • Born 1998/99 • 2 pupils with language difficulties • 1 Roma child	• Last floor • Get in slippers • Blackboard • Wall sheaths • 3 shelves • Desks in 2 rows • Carpet on back	• Influenced on teaching-learning of mathematics	• No one reacted on school bell • Lessons lasted 30 – 70 minutes • Pupils didn't want to stop some activities
Interviewed	• "found" herself in "Step by Step" • Loved children and liked her job • Role: directions, induces, motivate, gave signals	• Perfect concentration, excellent socialization and communication • Pupil of minority loved and respected	• Well equipped • Suitable sheared **Team work** • Teachers worked in team	•Treated as partners •Welcomed •Meetings •Workshops •Expectations •Helped in homework	•flexibility, no pressure, organization of lessons according to pupils gave, could spread or stop lessons

The teacher. The selected the teacher had 20 years experience and (4 years) university degree. She has worked with all lower grades of primary school (even in combined classes[17]). The teacher had undergone series of in-depth trainings, seminars, programmes, briefings and other forms of advanced training (Appendix 18). She was a trainer for other educators on Child Centred Methodology as well as on Reading and Writing for Critical Thinking strategies[18], where she 'found herself and got features'. Referring to her job, the teacher said that she loved children and enjoyed her work. She saw her role more important at home when she prepared herself for lessons. In the class she was 'the one who pulls ropes, who directs, induces, motivates, gives positive and negative signals ', and where she was not in the focus.

The class. The teacher worked in the third grade of nine-year primary school with 21 pupils, from which 11 were girls and 10 were boys. The teacher said that those pupils demonstrated perfect concentration, excellent socialisation and communication skills. The pupils in the class were born in 1998/1999. Two of them were considered as pupils with language difficulties. Pupils had different socio-economical backgrounds. 18 fathers and 6 mothers of those pupils were employed and 3 of them were divorced. One pupil was from a severely socio-economically deprived family. Pupils lived in the families consisting from 1 (1 of them) to 5 children (1 of them), but most pupils had one

[17] Combined class is class consisting of usually two grades with one teacher. It is practiced in schools with relatively small number of pupils where are no enough pupils for forming of separate classes (Hrasnica, Babić & Topić 2005).
[18] Those strategies were the courses for teachers and other educators within Centre for Educational Initiatives "Step by Step" which is a member of The International Step by Step Association.

sibling (11 of them). Pupils also had different ethnic-religious background. Thus, there was a Roma child[19] whom 'everyone in the class loved and respected'. The teacher considered differences as possibilities for teaching pupils to be tolerant and democratic.

The classroom. The teacher expressed her satisfaction with classroom's physical environment (Appendix 19) and the possibility to have all teaching materials which she needed for the work. The teacher acquired teaching materials through workshops which she led. In addition her school was always willing to participate and help. Thus, she had opportunities to get consumable materials and make copy of print materials. The school has also obtained textbooks and equipments for pupils who lived in hard social-economic conditions. There were also parents who bought necessary material and donated money in case of need.

Team work. Pupils shared the classroom with another third grade in the opposite shift. The teacher considered that such an organization was appropriate for both teachers and their classes because they used e.g. same panels. They worked alternately and there was nothing that disturbed and distracted pupils' attention. The teachers who shared the classroom also collaborated in making and exchanging teaching aids, they worked together on lessons preparations, making tests and realization of projects, as well as on organization of excursions and other after-school activities or projects and on that way 'saved time and themselves'.

Parents. During the lessons the pupils reported that parents had an influence on the teaching- learning of mathematics. Thus, during introduction of new contents one of the pupils said: 'My mother told me the same. First I have to add number up to tens and then add the rest'. The teacher explained that she treated parents as partners who tried to show that they were in the same position and that they shared the same expectations, dilemmas and problems towards learning of their children. According to the teacher, parents were always welcome to school to get information about their children on the individual meeting. She organized also workshops on teacher-parents conferences. The teacher expected parents to help pupils in completing their homework, follow exercises

[19] Ethnic-religion information about BiH population is described in more details in Dzemidzic (2007).

and support way of calculation learned at school, as well as being pupil's supporter, develop pupil's interest and positive attitude to learning. There was a situation during the assessment and homework analysis when a pupil solved exercise incorrectly and other pupils and the teacher reacted. The teacher explained her rule of discussion with parents in such situation where she provided help and pointed out mistakes or misunderstanding.

The time table. Even though a school bell was ringing after every 45 minutes to note the end or beginning of a lesson, the investigator noticed that neither the teacher nor the pupils reacted on the school bell. The observed lessons lasted from 30 to 73 minutes depending on the time which the teacher spent on teaching lessons (Appendix 13). That flexibility in time table 'without pressure that something has to be done' and freedom to be creator of time, the teacher described as advantage which make possibilities to the teacher that could organize lessons according to the class and 'pulse which gave pupils' and so she took as much time as she needed. She could stop lessons and continue later or she could spread one lesson in two. In that way, the pupils had enough time to express themselves. Such a situation occurred during the observation when pupils worked on teaching sheets which they could choose. When almost all pupils finished, the teacher called them to sit together in a circle on the floor. One of the pupils worked still on her teaching sheets. The teacher called the pupil by her name one more time, but she didn't react. The teacher left the pupil to finish her work and explained to other pupils that they would start with the next activity and that the pupil who was still working would join them later. Similarly, pupils didn't want to stop work/play and protested when they had to go for the English lesson in another classroom.

The study of Frame Factors showed that (1) the teacher was permanently in-service educated and that (2) the teacher loved children and her profession of teaching. Other findings demonstrated that: (3) it was a class with different backgrounds and diversity of educational needs; (4) the classroom was well equipped and the teacher was supported by the school and the parents in provision of teaching materials and aids needed; (5) the teacher worked in team with the other teacher, but also with the parents; (6) the parents helped the pupils in completing their homework; (7) the teacher used

time table and duration of the lessons flexibly with the purpose to meet pupils' interest for work and their educational needs.

4.1.2 Assessment

Through assessment teachers gather a chain of information which they interpret and use to make decisions about further activities. Findings about assessment attempted to answer 4 questions: which methods did the teacher use for assessment of pupils, what were her focuses and reasons for assessment, as well as how the teacher assessed her own work.

Table 6: Overview of Aspects Regarding Assessment

Methods	Focuses	Reasons	Teacher
• Observation • Pupils' works • Group assessment • Pupils' self-assessment • Pupils' file • Teacher's self-assessment	• Learning strategies of pupils • Emotional conditions • Acquired knowledge • Social conditions and interactions • At whole	• To getting to know pupils educational needs • To getting to know pupils' acquired knowledge • To self-assess own work • To see what she did and according to it go further • To know what else have to be done before start with introduction of new contents • To connect new knowledge on previous acquired • To know where to start • To may give feedback to pupils and their parents • To develop pupils' meta-cognition • To follow pupils' development • To get sing to return back if there is need	• Curriculum: Federal and Cantonal • Operational monthly plan and programme • Weekly programme • Written preparation for lesson
• Talking with parents • Letters • Diary			

The methods of assessment and content presented in Table 6 above are described in continuum. More of them are presented in direct connection with decision made about teaching.

Observation of pupils. The investigator observed that the teacher used to express her observed points and share them with pupils. It was noticed when the teacher assessed whether the pupils managed to meet the objectives of the lessons or not. Thus, the teacher said: 'You worked today very well and showed good knowledge. Some of you were slow, but all of you solved tasks at the end.' The teacher said that she focused her attention on observation on pupils' learning strategies and socio-emotional conditions. She observed that learning strategies of pupils were different. The teacher explained that some pupils corresponded more on visual aids while for others practical work, play or text were more suitable, as well as that some pupils may not cope with toy building

blocks but others were great at manipulating them, and that some pupils calculated on fingers and some understood immediately. The teacher allowed calculation on fingers and saw it only as a beginning process. The teacher also observed when some of the pupils had difficulties in mathematics and their emotional conditions. According to the teacher, for her sometime was enough to observe which of the pupils were active and participated in activity through their raising of hands. She observed expressions on pupils' faces and their behaviours, if some of them were withdrawn too much, or spoke too much, or may be interrupted. The teacher in such situations 'followed to observe that pupil', and then got him/her to say what the problem was or made situation to change his/her behaviour.

Assessment of pupils' work. The teacher assessed different pupils' work through revision of contents and through assessment of pupils' work on teaching sheets, test and homework.

Revision. At the beginning of the lessons the teacher assessed whether pupils mastered knowledge from the previous lessons or not. According to the teacher, she did it so that she could 'know where to start... found out pupils' previous knowledge and connect it to new contents which I intended to present'. The teacher revised previous contents in the following ways:

- Orally: (a) each pupil had task to solve one numeric expression, (b) questioned about maths terms ('What is meant by two digits numbers?'), (c) asked pupils to explain process of calculation (even pupils often gave correct answer, but the teacher continued questioning: 'How do you get that result?', and pupils explained ways of calculations). The teacher explained this as the simplest and the faster way of revision.
- Organized play: (a) for grouping (pupils solved numeric expression and according to the result they found the group to which they belonged), (b) *Correct – wrong* (pupils raised hands if the teacher said correct results), (c) *Find your place* (pupils calculated numerical expressions and according to the result they found which group they belonged to).

- Organized short quiz[20] *Fast maths dictation*: The teacher declared numeric expression, and pupils wrote down in the notebook only results.

Pupils' work on teaching sheets. To assess pupils' acquired knowledge the teacher used teaching sheets for group and individual work. Before the pupils started to work on teaching sheets they were briefly informed by the teacher which types of exercises sheets contained and how to solve them. The teacher also gave information about how they had been assessed: 'Each exercise solved correctly scored 3 points... a maximum of 15 points'. After completing teaching sheets for individual work, the pupils assessed their works themselves and analysed exercises on different ways[21]. Then the teacher assessed the number of correctly solved exercises and asked pupils to raise their hands. She also orally expressed what she assessed after pupils' group work on teaching sheets: 'Group had 5 correctly solved exercises ...'.

Pupils' work on test. After completing teaching units, the teacher evaluated pupils' acquired knowledge using a test on which pupils worked individually. Pupils' tests weren't numerically graded because in that semester pupils' acquired knowledge still was graded descriptively. However, the pupils got the points and at the end of the test the scales with number of points and what they represented were written. Thus, at the end of one of the tests was written: 6 – 10 sufficient, 11 – 14 good, 15 – 18 very good, and 19 – 22 excellent. At the end of test, the teacher wrote her comments to pupils. Thus, she wrote for one of the pupil: 'You made the test excellent. Continue with work as you start!' The teacher stressed that even there weren't numerical grades pupils were conscious enough that fewer points meant that they performed less successfully in the test or that maximum meant that they performed greatly.

Homework. The teacher assessed how pupils worked on their homework and made them to analyse their homework in pairs. In this peer assessment, pupils exchanged books and checked if the exercises were correctly solved. On another lesson, pupils read exercises from homework and other pupils checked in their notebook how they solved that exercise. Some pupils corrected if they didn't solve it correctly or wrote sign for

[20] Quiz is 'brief informal test' (Ornstein 1995, p. 410)
[21] This aspect is presented in sub-arena Texts materials.

correct answer (√). Homework assignments were the same for all pupils, although the teacher added bonus exercises to challenge some pupils (when writing on the blackboard what pupils have to do for homework). The teacher said that by assessing the pupils' homework she could have insight into their knowledge and what they didn't manage to learn. It was also sign for her to return to previous units and revise contents. With assessment of homework the teacher also assessed pupils' habits and responsibility towards work.

Assessment of the group. The teacher assessed how pupils worked in groups by giving them assessment sheets. There were three forms of assessment sheets (Appendix 20) for individual, for group and for the teacher. The teacher considered those sheets as big help because in that way she could assess all pupils at the same time. The teacher also assessed how groups worked and whether they respected the rules. She explained rules and induced them to self-assess their behaviour. Here is one of such situations:

> Teacher: 'How was your group work? Did you have good time together?'
> Amar: 'We quarrelled at the beginning about who will take the first exercise. No one wanted to begin. And, I decided to start ...'
> Belma: '...and than we agreed and everything was nice'.

The teacher expressed her opinion orally about assessed group work at the end of the lessons too. So, during one observed lesson after group work, teacher said: 'Members of groups worked together and agreed nicely, but some members just watched without participating'. The teacher expressed her opinion about how pupils worked and behaved by music also: 'You will get music as you were good'. The teacher turned on CD and pupils sang and danced. She stopped the music halfway and said: 'You said that you were a little good, so there was little music'. According to the teacher it was very important that pupils had constant reflection, self-reflection and that she motivated them on checking what is good, what is not and to question why.

Pupil' Self-assessment. The teacher organized work in which the pupils self-assessed their work. Pupils solved exercises on teaching sheets and then self-assessed their works. Each child gave him/her self points for correct answers and at the end summed up the total points. The teacher said that by giving pupils right to assess themselves, she developed their 'meta-cognition which helped them to understand what and how they

learned, as well as what else they have to learn', and she added that pupils could understand that they can make mistake but also that they can correct it.

Pupil file. From time to time, the teacher took teaching sheets, tests and other texts materials from pupils. She put them in pupils' file as 'possibility to follow and assess pupils'. Files consisted of pupil's drawings, teaching sheets and tests from different subjects and lists for assessments. There were lists for assessments of socio-emotional conditions. A mathematical list comprised teaching topics which the teacher took from the curriculum. The teacher drew symbols which presented: over average, average, satisfactory with help sometimes and below average with needs for additional help. There was also pupil's relation toward mathematical work in general: show interest, listen carefully and follow teaching, conclude without difficulties, actively participate in group work, ordinarily make homework. She wrote also her comments about what were observed. E.g., the teacher wrote for one of pupil:

> 'Azra works very hard and she tries to attain as much as possible. She needs individual help during assimilation of new contents and more time for it. There is a need for giving tasks more often but with fewer exercises. The pupil counts with materials easier than without.'

The teacher stated that this descriptive way of grading: 'It is more worthy one sentence than all numerical grades. What I have from 5[22] when I don't know what pupil acquired and what I graded? If I wrote that pupil has difficulty with solving an equation I gave clear guide for myself'.

Letters & Diary. The teacher told the investigator during the interviews that pupils wrote letters to her during the school's year. The class had special bag named *teacher's mailbox*. The teacher read letters first for herself and once a month together with pupils. There were also personal letters which the teacher didn't present to other pupils, but invited the pupil or his/her parent on an individual meeting. The teacher also said that she wrote information about pupils in her diary where she wrote what she observed.

Talking with parents. The teacher got to know pupils by talking with their parents. She was interested to find out a way which parents used when they helped pupils in

[22] 5 (excellent) is the best numerical grade in system of education for pupils in primary and secondary education.

completing their homework because they might find out some easier and suitable way of solving problems that pupils like.

Teacher's assessment of own work. The teacher often used assessment because: 'by assessing previous knowledge of pupils I can see what we did and then go further'. On that ways she used assessment of own work as help for getting decision about dilemmas[23] which appeared in teaching-learning process.

Curricula. For preparation of the teaching units for mathematics, the teacher used the Cantonal *Curriculum for third grade of nine-year primary school* (2005) which was modulated with Federal *Framework Curricula for I, II, III grades* (2005). The federal curricula contained: goals, expected outcomes of learning, contents and a pupils and a teacher activities. Expected outcomes of learning were broken into: knowledge, abilities and values, attitudes and behaviours. The Cantonal curriculum was broken into months and contained teaching plan and program[24]. The teacher made operational monthly and weekly plans and program according to the curricula and she revised them according to the needs of the class. The teacher was legally obliged to make daily written preparation for lessons[25]. She wrote: teaching lesson, date, objectives, types of teaching lesson, predicted teaching methods, classroom organizations, teaching materials and sequence of the lesson in detail.

The study of Assessment showed that (8) the teacher used a chain of different methods of assessment with (9) the purpose to get to know the pupils and their educational needs, as well as (10) to assess her own work. (11) The teacher used the information from the assessment to make further decisions. (12) The teacher also shared the information with the pupils.

[23] This issue have been presented in sub-arena named Dilemmas and possible solutions.
[24] Teaching Plan prescribes number of teaching classes which have to be studied. Teaching Program prescribes the contents which have to be studied. (Hrasnica, Babić & Topić 2005)
[25] Written preparation for lesson is 'plan for teaching lesson in written form which predicts the structure of the lesson' (Hrasnica, Babić & Topić 2005, p. 307).

4.1.3 Intentions

The intentions[26] are presented here through long-term and short-term objectives of teaching -learning process. Whilst long-term objectives presented broader intentions, short-term objectives were more precise and specific.

Table 7: Overview of Aspects Regarding Intentions

	Long-term objectives	Short-term objectives
Observed	Set up by teacher in form of monthly operational plan and program and in form of teaching units	Pointed out when instructed pupils Assessed whether reached or not Set up in the teacher's written preparation for lesson
Interviewed	All pupils should learn 4 basic math operations up to automatism	Small steps and activities which pupils reach in own speeds

Analysis of monthly operation plans and programs showed that the teacher set up **long-term objectives** from Curriculum. Those objectives were formulated in form of outcomes through teaching units which had to be realized during some months and according to Cantonal curriculum. For example, one of the objectives for October 2007 was acquisition of knowledge about addition and subtraction of two digits numbers. The teacher set up broader objective: 'All pupils should learn 4 basic mathematical operations up to automatism' until the end of school year what may be spread on next school year. The teacher said that she used long-term objectives as basis for setting up of short-term objectives.

Short-term objectives were directly formulated by the teacher. The investigator noticed that the teacher pointed out orally and writing on blackboard objectives of the teaching lessons. The teacher made it after revived contents at beginning of the lessons. She also assessed whether objectives are reached or not discussing them with pupils on the principle of question-answer or she orally expressed her opinions. The teacher considered those objectives as small steps and activity which she realised during the lessons. According to the teacher steps were sometimes more complex and then had to be modified in order to meet individual needs of the pupils. Steps could be also faster; it depended on pupils' reactions. Short-term objectives defined by the teacher were directed to the individual level, and not in comparison with other pupils in the class. The

[26] Aims and goals here were not presented, since objectives take place at class level what was focus of this study.

teacher described objectives which she set up in planning and realization of the lessons using Bloom's taxonomy and pyramidal development of cognitive domain as association. She said:

> 'It is like pyramid. A pupil's target can be middle of pyramid and it is currently his/her top. Every progressive step made by pupil is success and lead the pupil to target, to her/his top. It would be sad if the pupil stay on the bottom.'

According to the teacher, **the study of Intentions** revealed that (13) the pupils got possibility to progress in their own individual steps, but with (14) mutual objective to acquire the knowledge about 4 basic mathematical operations: addition, subtraction, multiplication and division.

4.1.4 Content

Content (Table 8) may be understood as syllabus, but also in relation with other aspects. Aspects of content in connection with teaching are presented and described through connection of content with daily-life situations and with other subjects.

Table 8: Overview of Aspects Regarding Content

Content as syllabus	Daily-life situations	Connection with other subjects
Set up from authorities in form of teaching plan and program	School in nature Role-play activities	Language Nature and society Sport and Art

Content as syllabus. The teacher set up contents from Cantonal curriculum. The content in curriculum is presented in form of the teaching plan and program prescribed for realization. The teaching plan for teaching-learning of addition and substitution prescribed around 21 lessons. Teaching program about addition and substitution was focused on one and two digits numbers up to 100, equations and unequally. However, the teacher adapted plan to conditions of class. Thus, she spent more time on teaching some contents than it is suggested by Cantonal curriculum. The teacher explained that she made that decision according to the assessed educational needs of the pupils. She found out that some pupils need more time for acquisition of knowledge.

Connection of mathematics with daily-life situations. Pupils collected money for 'School in nature'[27] which was planned to be realized at the end of the school year. The teacher used to integrate this issue in mathematical exercises, especially in applied solving problems. Thus, some of the exercises were in the following form: 'You collect money for School in nature. Mother gave you 56 KM[28]. Your aunt gave you 18 KM...' Mathematical content connected with daily-life situations were observed also in one of the lesson when a pupil had difficulty to solve task and the teacher repeated numerical expression, but that time instead saying just number (96), she added chocolates with number (96 chocolates). The teacher introduced role-play activities *In store, Money for School in nature* and *In Bank*[29] on which the teacher also adapted contents to daily-life situations. It is maybe interesting to present here how pupils experienced those mathematical games. On one of the role-play, the pupil said: 'When you are going to store to buy something you need maths, and now we have store in mathematics. We are acting like that we are in a store.' The teacher introduced daily -life contents named simulations. She considered them as necessarily because through using them and through the plays pupils could practise mathematical knowledge in more interesting ways and become familiar with them.

Connection of mathematics with other subjects. The teacher taught mathematical contents through linking them with other subjects. Thus, she connected mathematics with the following subjects: Bosnian, Croatian and Serbian Language and Literature (language), My Environment (nature and society), Body and Health Education (sport) and Art Culture.

Here are some examples of observed situations about connection of mathematics with language contents:

- Almir pronounced number incorrectly. The teacher corrected him and directed to repeat number correctly. For Almir, the teacher gave the some exercises which contained same number later in the continuum of the same lesson.

[27] School in nature is name for excursion which indicate trip with educational purpose and in duration of several days.
[28] KM is abbreviation for Convertible Mark in Bosnian, Croatian and Serbian language and officially BiH currency.
[29] Those role-play activities are described later in the arena about teaching materials.

- Igor wrote the name with small letter on the teaching sheet and the teacher directed him to correct the error.
- The teacher insisted that Sanela would answer using full sentence because Sanela the day before used simple vocabulary in writing of essay (on the language lesson).

Mutual contents of mathematics and the subjects My Environment were noticed in the mathematical lesson when the teacher wrote the date on the blackboard. That was the first day of autumn and the teacher reviewed previous knowledge about characteristic of this season. The teacher also said that she needed mathematical knowledge when she taught contents about plan, sketch and presentation of thumbnail of objects in this subject.

The teacher organized one part of the mathematical lesson in connection with sport. The teacher threw ball and pupils caught. Pupil who managed to catch the ball worked on solving exercise. The teacher said that she used mathematical contents in Art Culture too when teaching about forms and colour.

According to the teacher, contents of mathematics connected with other subjects, used in different situations and on different lessons helped pupils to understand that mathematics is everywhere and that there were no separate subjects, as well as she made possible acquired knowledge to be applied.

The study regarding Content showed that (15) the teacher used contents posted by the educational authorities, but she also adapted the teaching plan to class conditions. (16) The study also indicated that the teacher connected contents to daily-life situations and (17) to other subjects with the purpose to motivate the pupils for learning and made contents more familiar to them.

4.1.5 Teaching Methods

The teacher used different teaching methods (Table 9): dialogic method on principle question – answer, demonstration, discovering and learning through errors as method,

problem teaching as heuristic method and play[30]. There was conducted also individual teaching. The teaching methods were utilized during the same lesson in different combinations two or more of them.

Table 9: Overview of Different Types of Teaching Methods

Dialogic method	Demonstration	Discovering	Problem teaching	Individual teaching
Principle question-answer: • scaffolding pupil to solve tasks • New knowledge built on previous acquired	• teaching materials • blackboard • papers	• Individual errors • Group errors	• Setting of problems • Different ways of calculations	• of pupils who showed difficulties • on separate place while other worked on tasks

Dialogic method on the principle of question – answer. The teacher built new contents on previous knowledge and by principle from known to unknown. She led pupils step by step in solving tasks and asked additional questions. Example of such method presents following situation: the pupils already acquired knowledge about ones and tens. The exercise was written on fixed big paper on flip chart: 37 + 5 = 37 +...

Teacher wrote and spoke: 'Number 37 is prescribed. How many ones we have to add to number 37, thus that 37 will be full ten?'
Pupils: '3'
Teacher: 'From which number we took 3?'
Pupils: 'From 5'.
Teacher: 'How much is rest of 5?'
Pupils: '2 ...'

Demonstration. Ways of calculation were demonstrated in two ways: using teaching materials and making notes on the blackboard or on big papers. When demonstrating calculation, the teacher used different objects[31]. The teacher, after demonstrating an example of calculation with materials, wrote on the blackboard or on the big paper how they solved exercise. And vice versa, the teacher sometimes first demonstrated the way of calculation by writing and then by teaching materials. She wrote on the blackboard or papers fixed on flip chart what she spoke about and therefore demonstrated the way of calculating. The important elements of calculations were also underlined, drawn and encircled (Appendix 21). Calculating was demonstrated by the teacher and also by the pupils. The pupils didn't copy notes from the blackboard during teacher's

[30] Play is presented as part of different other arenas.
[31] Used teaching materials are presented in separate arena about object within teaching materials.

demonstrations, but they followed teaching, commented and participated in solving of exercise.

Learning through discovering errors as method. Pupils made errors when they worked on teaching sheets in groups or individually. The teacher used their errors to introduce learning by guiding pupils to discover the errors. Thus, in one of the lessons, the groups presented their work in front of the class. Group A solved numerical expression in the following way: 34 + 25 = 34 + 2 + 5 = 34 + 2 + 5= 34 + 6 + 1= 41. Other pupils reacted by pointing out the error. The teacher gave working paper of group B to group A. The teacher guided members of group A to analyse solved exercised of group B. She asked additional questions: 'What did group B[32]? How did they decompose number 27?...'. One of the pupils from group A discovered where the group made an error: 'We didn't decompose number 25 correctly.' The teacher said that she encouraged pupils in discovering similarity and differences, to verify and check what they were doing, and learn from own mistakes.

Problem teaching as a heuristic method. Problem situations were organized several times by the teacher. The teacher questioned or formulated tasks and exercises in forms of problem situation. Pupils spontaneously organized themselves in groups to work on tasks. They could use materials, papers for writing or whatever they needed in solving of the tasks. Such task in one of the lessons was to formulate equation: 'Maja paid for shoes and trouser 31 KM. She paid 12 KM for trouser. How much did Maja pay for shoes?' Group 1 formulated equation in form 31 – X = 12 and group 2 formulated it differently 12 + X = 31. The teacher used thet examples in continues of teaching.

In another maths lesson the task was to solve numerical expression 24 + 15 on more possible ways of calculation. The teacher gave the pupils possibility to solve the problem first alone, and than added one more example of calculation. Although one of the pupils demonstrated solved numerical expression with toy building block (hence, with teaching materials) another one wrote it on the big paper: 24 + 15 = (20 + 10) + (4 + 5) = 30 + 9 = 39, and the teacher offered one more way of calculating: 24 + 15 = (24

[32] Solved exercise of group B was 31 + 27 = 31 + (20 + 7) = (31 + 20) + 7 = 51 + 7 = 58

+ 10) + 5 = 34 + 5 = 39. In continuous, pupils solved exercises in the accordance with the ways that the teacher introduced. The teacher explained that she didn't mean that some ways of calculation were better or easier, but they were dictated by the curriculum.

The teacher said that she tried as much as possible to introduce practical work and approximate problems situations with intention that pupils don't learn only facts, but that they develop critical and different ways of thinking. Problem situations for the pupils, the teacher considered as hooks for their motivation and expression of thinking.

Difficulties and Individual teaching. Attention by the teacher was given visibly when some of the pupils showed difficulties during the teaching-learning process. The teacher instantly or in the course of the lesson tried to solve them in the following ways: (a) offered teaching materials as help with calculations, (b) offered the pupil to write if s/he couldn't express orally, (c) repeated the question one more time or several times, (d) called pupil in front of the blackboard and helped him/her to solve the task, (e) adapted mathematical language and contents to real-life situation, (f) utilized role-play and (g) individualized teaching and separately worked with pupil.

The teacher taught pupils individually during the same lesson. While other pupils worked in group or individually on teaching sheets, the teacher worked with the pupils that were: absent from school the day before (2 times), in the library during introduction of new content (1 time), showed difficulties in calculation in some part of the lesson (2 times), asked for help (2 times). Whenever individually taught the teacher sat in separate desk with the pupil (one time at the back of the classroom on the pillows on the carpet) and they worked together in the following steps:

1. The teacher demonstrated the way of calculation with materials (usually toy buildings blocks) and explained what she was doing. The pupil observed.
2. The teacher offered material to the pupil, led her/ him to solve the problem too.
3. The pupil wrote with the teacher's help what they did with material. The teacher helped the pupil leading her/him and asking additional question.

4. The teacher set up new task and the pupil trying to solve the problem alone, without help.

The teacher said that her intention wasn't to make one row of methods, but to know how to use those which she selected at the right time The teacher described that some pupils couldn't express themselves orally, but could do it very well by art or writing, that one of them had to always hold something in hands and other one needed to be active as much as possible, as well as that some pupils needed more visual approach as there were notes on the blackboard. Thus, by using multiple types of methods the teacher respected individual differences and educational needs of the pupils.

The study of Teaching Methods indicated that (18) the teacher used a variety of teaching methods (19) differentiated them and (20) applied two or more of them during the same lesson. The findings also indicated that (21) teaching methods consisted of: guiding and scaffolding, direct involvement of the pupils in tasks, direct teaching and pupils' engagements in dialogs and with materials. In addition, (22) especial attention by the teacher was given to the pupils who had some difficulties in learning.

4.1.6 Peer Support

The pupils worked on the same lesson and they engaged in the same activities. Peer support included aspects presented in Table 10:

Table 10: Overview of Aspects Regarding Peer Support

Observed	Interviewed
- Group work - Pupils undertook the teacher's role - Voluntarily helped - The teacher invited pupils to help - The teacher directed pupils on each other - The teacher supported pupils initiative to work together	- Support and cooperation – basis of the class - Feelings of belongs and confidentially - Pupils learn better - Social skills

Peer support was noticed during group work organized by the teacher. However, pupils supported and helped each other even when the teacher didn't organize group work. Thus, pupils often undertook the teacher's role of teaching and instead of her helped fellow pupils who had some difficulties in calculation. E.g.:

On one of the observed lessons one of the pupils attempted to solve numerical expression 40 – 6: 'We take 1 ten from 40 and than from 40 subtract...The other pupil interrupted and indicated the mistake '...not from 40. You was already take away 10. From that 10 subtract 7. How much is it?"

Pupils voluntarily offered help to each other and they also accepted the teacher's invitation of 'team support' and 'help each other'. The teacher invited pupils to help if some of them had difficulty: (a) directed pupil ('Alen, show Belma what task we reached.'), (b) asked the pupil to help other because 'You are already finished your task', (c) invited of 'team of support' to help and (d) suggested the pupils to exchange phone number in order to ask each other what is for homework if they forgot.

The teacher also directed the pupils to ask each other for help. E.g., on one of the lessons, the teacher was busy with individual teaching and one of the pupils asked her to check whether he solved exercises correctly or not. The teacher instructed pupil to check results with the other pupil whose work was already checked. In another lesson the teacher instructed one of the pupils to ask for help from group members. According to the teacher support and cooperation were basis of the teacher's class which was very important for pupils feeling of belonging and confidentiality. The teacher noticed that the pupils learn better if they cooperated and supported each other.

The study of Peer Support revealed that (23) the pupils supported each other during the joined activities and (24) on the teacher initiatives. (25) The teacher also supported pupils' initiatives to help each other and to work together. (26) However, the pupils also helped each other voluntarily and (27) they took the role of teaching.

4.1.7 Classroom Organization

During teaching and learning mathematics, the teacher used three forms of the classroom organization: whole class approach, group work and individual work.

Table 11: Overview of Different Types of Classroom Organization

Whole class approach	Group work	Individual work
• When was this approach used? • Forms of all class approach • How and where did pupils settle?	• Chain of different activities • Grouping • Work in pairs	• On the teaching sheets • On the test • If prescribed notes

Classroom organization was differentiated and during the same lesson there were applied two or all of them. E.g., on one of the lessons the teacher presented new content to the whole class and then the pupils were grouped. In groups they individually solved one of the tasks on teaching sheets.

Whole class approach was usually utilized at the beginning and at the end of the lessons. The teacher organized whole class approach while she: (a) revised contents at the beginning and the end of the lessons[33], (b) taught new contents and explained the ways of calculations, (c) analysed solved tasks and exercises[34], (d) gave feedback[35] to the pupils and (e) directed, explained and described activities and rules, as well as how to work on texts' materials or games in the group or individual activities.

Whole class approach occurred in four forms. More usual forms were teacher's directions to the pupils. However, the pupils often took over teacher's role in teaching (second form of all class approach). There was also form in which group of the pupils directed to all class, as well as form in which the teacher worked with one pupil while other pupils followed up what they did.

Pupils in these activities sat on the desks in groups or sat in the circle at the back of the classroom on the pillows on the carpet (usual). The teacher was also with them. She sat pupils in the circle at the back of the classroom especially at the beginning of the lessons. The teacher said that this place was 'world from all other beginning' and used for evocation and revision of content from the previous day, for introduction of events, explanation of further activities and preparation of pupils for them. It was a place also helped teacher to speak with pupils and observe them and get to know their emotional conditions and moods. The teacher noticed better motivation and concentration when pupils looked at each other and extended the pupils' feeling of safety and belonging in such classroom organization.

Group work was mainly introduced when the teacher reviewed and practised contents. The teacher organized group work activity differently in the following ways:

[33] Revision has been presented as part of Assessment arena.
[34] Analysis of tasks and exercises is presented as part of arena Teaching Materials.
[35] Feedback to the pupils is presented as part of arena named Teaching materials.

- Social game: *Reach the finish line* (Appendix 22, within texts materials). One group consisted of 4 pupils. Each group played the same game. The game was on the big paper. There were fields with numerical expressions and direction of what should be done (e.g.: If you don't know how to solve the exercise, ask peers for help). The pupil cast a die. Die showed which task (field) the pupil had to solve. The pupil wrote the ways of calculation and the result on stickers which were then pasted on paper. One pupil solved one task and the next pupil continued with play until all fields were solved.
- *In circle, in circle*: Pupil solved one of the exercises on the teaching sheet. Other pupils from the group followed what s/he was working and helped him/her if it was necessary. The next pupil continued work on the sheet when the exercise was finished. Similarly organized group work on teaching sheets was with casting of dice which determinate the number of the exercise that the pupil had to solve.
- The group members worked all together on one exercise which was pasted on a big paper. They used toy building blocks first to solve numerical expression, to draw way of calculation and presented it numerically.
- Problem teaching initiated group work several times. Pupils organised themselves spontaneously and worked on problem solving.

The teacher stressed out that the advantage of the group work was possibility of teaching-learning process in which the pupils had to count on each other whereby the pupils learn individual and group responsibility. Also, in this way, the pupils learned more and reflected their knowledge better than it would be possible with whole class approach. The teacher used different ways of grouping:

- Counted colours: red, green, blue, yellow;
- According to the result of solved numerical expression *Find your place:* pupils calculated numerical expression and according to the result they found the group they belonged;
- According to the form of numerical expression – same as *Find you place* but instead of the results the pupils found the group they belonged according to the forms of calculation;
- According to the opinions how tasks had to be solved on problem teaching

- Through play *Atom*: Music played on CD and the pupils danced and sang. The teacher said: ‘Atom 1 + 1’ when music stopped. Pupils held hands in pairs. The music started again and the pupils danced and singed. The teacher stopped the music and said: ‘Atom 2 + 1’. Three of the pupils formed a new group. The music started for last time and the teacher tuned off the music after sometime telling: ‘Atom 3 + 1’. There were four pupils in each group.

The teacher explained that grouping depended on the teaching units and the objectives of lesson. Thus, groups were sometimes heterogenic and sometimes homogenous. Heterogenic groups were set up if the teacher organized the group work on teaching sheets with different exercises for everybody. The groups were homogenous if the teacher had an intention to meet the pupils’ needs for faster progress. The teacher for homogenous group prepared exercises which were more complicated and harder. The teacher used different form of grouping and in that way ‘taught pupils of better and more successful cooperation, collective and inner relationship’. Work in pairs was also observed when the pupils checked homework to each other. According to the teacher, such classroom organization had the same advantages as group work.

Individual work. Pupils worked individually on teaching sheets, test and if they wrote down from the blackboard. If they individually worked on the teaching sheet, the teacher demanded that the pupils worked alone and without help, but she gave help to the pupils who didn’t attend the class the day before. If the pupils worked on the test, they did it independently. The teacher explained that she insisted on independent work in those situations in order to know whether the pupils acquired knowledge.

The study of Classroom Organization showed that (28) the teacher differentiated classroom organization and that (29) during one lesson she used combination of two or all of them. (30) Whole class approach was used in all sequences of the lessons by the teacher with the purpose to give the same information to the whole class and to assess the pupils. (31) The members of the groups cooperated and supported each other in solving the tasks in different ways. (32) Whole class approach and group work involved different forms while the teacher, the group and one of the pupils exchanged the

teaching roles. (33) The pupils independent work on texts materials served for the purpose of assessment.

4.1.8 Teaching Materials

Hands-on activities included direct experience with materials in teaching-learning mathematics. In that sense, different teaching materials such as texts materials, objects and body were employed.

Table 12: Overview of Different Types of Teaching Materials

Texts materials	Objects	Body
Teaching sheets Test Textbook Big papers with numerical expression Cards with numerical expression	Toy building blocks Straws Wooden chips *Money*	All body as medium Fingers

4.1.8.1 Texts Materials

Observed texts materials included (Appendix 22): teaching sheets, tests, textbook, cards and social game.[36]

Table 13: Overview of Different Types of Texts Materials

Teaching sheets		Test	Textbook	Big paper	Cards
Individual work: - self-assessment - additional sheets	Group work: - One exercise – exchange - More exercises – additional sheets	• For assessment by teacher • Same for all pupils • Feedback on next day	Rare used: • Homework • Equations	• A 3 format • With one numerical expression	• For grouping • With numerical expression
• Chain of analyses					

Teaching sheets: There were teaching sheets prepared by the teacher for group and individual work. The teaching sheets for groups had two forms:

- Form with only one exercise: The members of the groups together worked on the teaching sheets with only one exercise and when they finished, they exchanged them with other groups;
- Form with more exercises or with only one task but with more sub-exercises within the task: The members of the group solved together or one group's member solved one exercise (*In circle*). Dice determined which exercise should be solved or members in the

[36] Game "Rich the first line" was previously described as part of sub-arena Group work and within arena named Classroom organization. Here was not described separately.

group solved only one exercise in a series. If the members of the group finished exercises on teaching sheets before other groups, they got additional one.

The teaching sheets on which the pupils worked individually were used for self-assessment and for practice and revision of the knowledge. While all pupils had the same teaching sheets if they used self-assessed, they got to choose which of the teaching sheets they wanted to solve when they practised and revised the contents. Additional teaching sheets were placed also in bags hanging on noticeable place and the pupils could choose them during the lessons when they finished the tasks. The teacher considered additional teaching sheets as especially favourable for certain pupils who acquired contents faster because if challenges were bigger, the pupils worked more and not bored. When the working sheets were finished, the teacher analyzed them with the pupils on the same lessons. The pupils checked if they solved exercises correctly or not in the following ways:

- One pupil read one task for other pupils
- The teacher gave feedback by giving the teaching sheets with correctly made results
- The teacher wrote correct results on blackboard
- The teacher fixed the teaching sheets on the blackboard with magnets. The teacher and one pupil from the group analysed the exercises of group while others followed up, commented and actively participated suggesting results if there was a need.
- The members of the group presented their group work in front of class and all other pupils were listening and checking it.

Test. After going through a certain teaching unit, the teacher gave the pupils a test for the purpose of assessment. The teacher first explained to pupils how to work on the tests, reading each exercise, describing how to solve it and asking additional questions to check if the pupils understood mathematical terms. The pupils worked on the same test. Then the teacher corrected the test and gave feedback at the next lesson. When giving feedback to the pupils, the teacher took care about their feeling. E.g.: The teacher gave feedback to each pupil and analysed his/her success. She called the names of each pupil, announced the score, said something positive about her/his work (e.g. ‘In each

exercise you correctly solved some exercises') and what was not correct, as well as possible reasons and what the next step was (e.g. 'We will work together on those tasks at extra teaching lesson, ...try now one more time'). Pupils who obtained high scores got spontaneous applause. Applause got also pupils who didn't acquire high number of points, but the teacher told them that they progressed if compared to the previous test. One pupil was not marked (he acquired 1 point) and teacher didn't say it. She said 'We need first to work one more time together on this test and then I will mark your test'. The pupil was visibly happy. The teacher also assessed how the pupils felt after the feedback. One of the pupils said that she was afraid and they discussed about it altogether.

Textbook was used only for assessment and checking homework at the beginning of the lessons (one time) and for practice of solving of equations (one time) at the end of the lesson. According to the teacher, teaching was established more on teaching sheets than on text books because '... teaching sheets are more effective. I know my class, I know what pupils can and how much, what they want and I make teaching sheets according to them'. The teacher added that the textbook was used occasionally and for the pupils' practice for themselves.

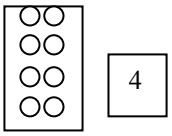
Big papers (A3 format) with one numerical expression were also used. The pupils in the groups had to write on the papers way of calculation, result and draw how they calculated (the pupils used toy blocks first, and than draw it).

Cards with numerical expression were used for pupils' grouping according to result (one time) and according to the forms of calculation (one time).

4.1.8.2 Objects

Teaching-learning process required different objects on mathematics introduced by the teacher (Appendix 23). Those were: toy building blocks, straws, wooden chips, "money" made by papers.

Table 14: Objects as Teaching Materials

Toy building blocks	Straws	Wooden chips	"Money"
			

Toy building blocks[37] were considered by the teacher as a good didactical medium, good material for combinations and material closer to pupils that enabled the better understanding of contents. Building blocks were introduced as teaching material in several situations:

– for presentation of tens and ones - longer blocks presented tens and shorter ones
- for calculation: addition and substitution
- for grouping – teacher counted pupils: red, yellow, green, blue. Coloured blocks were on the desks and on that way determine where pupil had to sit
- for presentation of relations: >, <, =

Straws were used almost in the same way as toy blocks:
– for presentation of tens and ones: 10 tied straws presented tens and 1 straw presented ones
- for calculation: addition and substitution
- for presentation relations as teaching aid : >, <, = between two sides and differences between equation and in equation
- for presentation of money in role-play *In a store*: The pupil had 22 KM[38] and needed to buy candy for 9 KM. Change had to be correct returned. The teacher acted as seller and the pupil acted as customer.

Wooden chips were used to represent money when solving equations. One of such exercise was: 'Maja paid for shoes and trousers 31 KM'. One of the pupils threw into cloth bag 31 wooden chips. 'Maja paid 12 KM for trouser'. Another pupil took out 12 wooden chips from the bag. When solved equation the pupils counted how many chips rested in the bag and on that way checked whether they solved the task correctly.

[37] known also as Lego toys or blocks and construction toy.
[38] KM is abbreviation for Convertible Mark in Bosnian, Croatian and Serbian language and officially BiH currency.

Money presented small papers on which the circles were drawn. They were used in role-play *Money for School in nature*. In the play, the teacher presented exercise: 'We are collecting money for School in nature. I am your mother and giving you 40 KM. Your sister gives you 4 KM and aunt 28 KM. How much money did you manage to collect until now?' Pupils acted the situation and counted *money*. Similarly, pupils acted and counted *money* on solving exercise: *In a Bank*.

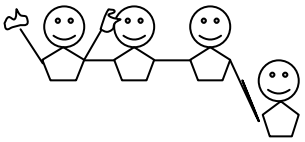
The teacher said that teaching units and planed activities determined which objects to use in the lessons. Thus, sometimes it was more practical to manipulate with tips hence they could be easy counted, while straws allowed better presentation of tens. 'Objects could be some other materials too, for example beans' said teacher.

4.1.8.3 Body

The teacher used body and hands as teaching medium for demonstrating the process of calculation. On one of the lessons the exercise was: 40 – 6. Pupils had the role of number where their body presented tens and where fingers presented ones. The teacher led play (saying what to do) and the pupils acted (performed).

> Pupil A[39]: 'I am first tens and I have 10 ones'. The pupil rise hands and show 10 fingers. Pupil B, C and D did same and than they joined hands. Pupil D showed hiding of (bending) of 6 fingers.

A B C D



30 + 10 - 6 ...

The teacher explained that by introducing different teaching materials, the teacher's intention was to bring mathematical problems closer, induce pupils to think differently than usual and solve tasks and got results on the most simplified ways, through plays and close situations.

The study of Teaching Materials resulted in several findings. Those are the following: (34) the teacher utilized different teaching materials in teaching activities and she

[39] Letters don't present the pupils' initials of names, but alphabetical order in which the pupils are presented sequences.

differentiated them; (35) teaching sheets were mostly used, (36) while the textbook was used seldom because teaching sheets were more appropriate in meeting the needs of the pupils; (37) the teacher employed additional teaching sheets for groups and also for the individual work; (38) teaching sheets for group work were different , while (39) teaching sheets for self-assessment were the same for all the pupils while they practiced and revised the contents, (40) the pupils had possibility to choose the additional teaching sheets after the pupils finished working on the main teaching sheets, (41) the teacher used different ways to analyse the teaching sheets, (42) the tests were used for the purposes of assessment and they were the same for all the pupils, (43) the teacher took care about the pupils' feeling when she gave feedback to each pupil and analysed his/her success[40], (44) objects as teaching materials were used for demonstration, (45) pupils were directly involved in hands-on activities by using objects, (46) the teacher utilized daily-life situations through role-plays, (47) objects were chosen by the teacher according to their practical functions, (48) body and fingers were used as medium.

4.1.9 Communication and Care

The focus on communication and care 'represents an extended view of education' (Johnsen 2001, p. 288). Findings within this arena included four main foci: socio-emotional atmosphere, care, praise and discipline.

Table 15: Overview of Aspects Regarding Communication and Care

Socio-emotional atmosphere	Care	Praise	Discipline
Laugh, funs, jokes	Emotional conditions	Praise for group	Rules
Music	Behaviour	Praise for individual	Nonverbal sings
Support of pupils' initiatives	Teacher's attentions	Writing on pupils' work	Pupils solved problems
Induced between pupils	Extra time	Applauses	Time out

Positive **socio-emotional atmosphere** was noticed in every observed lesson. Laughs, funs, jokes during lessons were visible especially in organized group work activities and plays. The teacher created comfortable atmosphere and turned on CD player while the pupils worked in groups. The music was quiet and favourable. However, the pupils refused music when teacher offered them the test for self-evaluation and when they had to work individually. The teacher supported the pupil's initiative visibly and respected

[40] This finding is in relation with arena Communication and Care.

their decision. She also often answered on pupils' initiative to solve exercises instead of her. The teacher induced positive climate between pupils too. One of the many examples was when the pupils checked homework to each other in the textbooks and had to draw signs √ for correctly solved exercises and cross out (X) for incorrect ones. The teacher instructed them that they did it tidy 'so that the peer don't be upset'. At the end of the same homework the teacher also gave instruction to the pupils: 'Write down something on peer's homework. Let's it will be 'support words'.

Care. The teacher paid attention to different pupils' emotional conditions especially on moods and feelings. Thus, she noticed sadness of Ana who gave wrong answer during the review of contents. Later the teacher offered Ana main role in the activity (role-play) and this visibly changed her sadness to happiness. The teacher also noticed sleepiness of Faruk and different behaviour of Kerim and spoke with them. Dunja read what she wrote for homework and she was very silent. The teacher walked up to her and noticed that her palms were sweating. She put her hands on Dunja's shoulders and continued reading of homework together with her. The teacher explained that she together with the pupils tried not to hurt fellow pupils' feelings. She observed the pupils and made possibility for them to express their feeling and thinking. It was very important for the teacher that the pupils didn't feel ignored and hurt by her or peers, that they understood each other and had enough time to express themselves. The teacher also paid attention that: every pupil could be seen by the teacher and the class, all pupils could see activities, each pupil gave answer on some question or said something during the lesson, everybody could hear what she was talking about, the pupils had enough lights in the classroom, the pupil found his pencil-case lost day before (the teacher and all the class helped), the pupils had enough fresh air in the classroom, pupils had enough space for work (organized their materials on desks), all pupils set on the pillows if they worked on the carpet, all pupils set straight on the chairs, all pupils had sleepers on their legs, suggested the pupils how to dress (dress light clothes under worm jackets because it was cold outside and was warm in the classroom).

The teacher paid attention also on needed time. Thus, she left enough time for the pupils to give answers. According to the teacher it was completely natural that some pupils

needed more time for thinking and that it was her intention ‘thinking alone would enable each pupil to arrive at an answer instead of waiting just to be told the answer’. The teacher insisted also that other pupils should give enough time to fellow pupils who needed it for answering the questions. She explained that by waiting and giving extra time to the pupils, who needed it, the pupils showed support for that pupil and this led to the development of self-confidence.

Praise. The pupils showed satisfactions when they were praised. The teacher praised groups and pupils individually too. The groups have got praises for silent but active work, if they solved tasks correctly and because they cleaned the classroom and found the place for toys and other staff (cleaned mess in the classroom). The teacher also praised group writing on their teaching sheets “Bravo!” Individually prised pupils were those who correct solved task and helped each other. Pupils got applause too. Those were pupils who were ‘the most confident in calculation today’ and who was ‘especially active during the lesson’. The teacher said that with applause they showed that ‘we are with her/him and her/his success is ours too.’

Discipline. Matters of the class discipline were manifested through teacher’s attention on groups and on individual pupil. The main characteristic noticed was the teacher pointing out on following of the behavioural rules in group work activities. The teacher explained those rules to the pupils before they started the group work: orally, writing on the blackboard and reading them from the papers hanging on the wall. It happened on one of the lessons that pupils were noisy during grouping and the teacher sent them back to their previous places. By discussing with the pupils and repeated rules the teacher led pupils to understand her decision. She also stopped the group work in one lesson when the pupils had difficulties in organizing themselves and led pupils to principle question – answer to revised rules. The teacher gave signs to the pupils to be silent nonverbally: raising her hand up, clapping the hands and putting her finger on her mouths. The teacher insisted on the pupils listening to each other without interrupting and jumping in word and they had to raise their hands if they want to answer her question instead of ‘speaking in chorus’.

The pupils sometimes solved misunderstanding that cropped up for themselves and without teacher's initiative. In that sense, the pupils discussed about different results on the solved problem and one of the pupils called other to raise her/his hand and on that way reconciled opinions. The teacher described this as a situation in which the pupils showed that they know how to assess when someone was not in the right.

Attentions toward individual pupil's behaviour were realized through the teacher: direction of the pupil on respect of class rules, called the name of restless pupil and giving self-evaluation sheets for the pupil who didn't participate in the group work. The teacher also used time out for pupils who disturbed (constantly spoke with) others during the work. On the one of the lessons she sent the pupil to sit on a pillow at the back of the classroom and follow the lesson from there. In another lesson, the teacher and the pupils were at the back of the classroom. The teacher reviewed the contents and one of the pupils laughed all time. The teacher sent the pupil to sit on the table and added that he could come back when he was ready to continue and follow the lesson. The teacher considered short time-out as well affected for the pupils describing it as possibility for the pupil to reconsider his/her behaviour.

Study of Communication and Care involves the following findings: (49) positive atmosphere was ensured through enjoyable activities; (50) the teacher adapted to the pupils and supported their initiative; (51) the teacher taught the pupils to positive interacted; (52) the teacher demonstrated interests, responsibility and care about the pupils emotions, their things and physical condition, as well as classroom condition; (53) the teacher gave praise orally by expressing her satisfactions, writing on the pupils' work and applauded; (54) the teacher gave to the pupils the possibility to express their feelings and opinions; (55) the teacher paid attentions on the class discipline and to each individual pupil.

4.1.10 Other Topics

Lastly, the tenth embedded arena was named Other topics. As the name suggests, findings of some aspects which didn't belong to any of the arenas of the modified CRM were placed here. These were two sub-arenas: Extra Teaching and Extra Activities.

Even though some of the findings from this arena could belong to the previous arenas, the investigator's opinion was that those sub-arenas present different aspects.

Table 16: Overview of Aspects Regarding Other Topics

Extra teaching	Extra activities
Pupils and the teacher initiatives Obligatory and good willing lessons	Saving money for School in nature Visit to Bank

Extra teaching (supplementary instruction). The pupils reported several times that they would stay on extra teaching lessons or asked the teacher about when those lessons would take place. The teacher also invited pupils to attend them. Invitation was intended for the pupils that didn't attend school in the previous days or for longer period of time, as well as pupils who showed difficulties during the lessons and for those who asked for help. Extra teaching was organized once a week. The teacher organized also extra teaching in continuum one week a semester. Continuous extra teaching was the teacher's good will to help pupils and meet their educational needs. It wasn't part of teaching plan prescribed by legislation. The teacher said that during those lessons, she worked individually with the pupils who needed some help and who didn't acquire necessary knowledge. The pupils liked to attend these lessons because they got more attention by the teacher and they 'became more visible'. The teacher had more time to pay attention to each of them and be closer. There weren't big differences between the pupils and so they acquired self-confidence and motivation for learning.

Extra activities. There were also two more extra activities organized by the teacher: saving money for *School in nature* and visiting the Bank. Each of the pupils had the bag in which they collected money and then together with the teacher they saved in the bank. The teacher used this as possibility to motivate pupils to practice mathematical contents on the lessons. The teacher considered those extra activities as advantages: 'Those activities induce and make the curriculum better and more interesting. It is not rigid and the pupils may learn and acquire knowledge from one more different angle'.

The study of Other topics addressed that (56) the teacher introduced extra teaching lessons once a week in order to meet educational needs of the pupils. (57) In addition she organized extra teaching in continuum one week each semester. (58) Extra (out of

school) activities were also inducted and (59) used with connection with ordinary lessons.

4.2 Challenges Met by the Teacher and How She Conforonted Them

The second research question was: Which challenges does the teacher meet in teaching-learning of mathematics, and how does the teacher confront these challenges? Answers to these questions were obtained through collected data from the interviews. Challenges which the teacher considered as dilemmas and problems here have been presented in the two sub-arenas. First sub-arena was named Dilemmas and possible solutions (Table 17) and the second is named Problems and how they were confronted (Table 18). Findings indicated that the teacher linked dilemmas to all aspects of teaching-learning process, while the problems were more focused on frame factors.

4.2.1 Dilemmas and Possible Solutions

Table 17: Overview of Expressed Dilemmas and Viewed on Possible Solutions

Dilemmas	Solutions
- All teaching-learning process - Pupils who progress faster than others - Pupils who need more time for acquiring of knowledge - Assessment of pupils work - Teaching strategies - Plan and programme	In making decision helped: - Experience - Method try and fault - Intuition - Willingness and need for investigation and searching of solutions - Self-reflection - Got to know class

According to the teacher, dilemmas emerged in almost all parts of teaching-learning process. She described the teaching- learning of mathematics as a complex matter in which she everyday tried together with the pupils to find the best way for realization of daily plan. According to the teacher, dilemmas helped her to select the best decision.

The teacher's main dilemmas were connected with those pupils who progressed faster or slower than the majority of other pupils. She questioned herself whether it was better for the pupils who acquired knowledge faster to introduce new contents or guide them to help other pupils as way of making them to practice a little bit longer. Concerning the

pupils who needed more time for learning her dilemma was toward teaching sheets and tests. She wondered if giving the pupils who progressed slower than others different teaching sheets from their peers would influence them negatively. May be pupils could be labelled and segregated in that way without being given chance to try. However, the dilemma was also about what would happen with the pupils who could not solve the exercises if given the same teaching sheet or test as other pupils. The teacher questioned herself about the pupils' feelings when they did not obtain any points. As a solution, she preferred making teaching sheets and tests which contained the exercises for everybody or as she said: 'There will always be at least an exercise which each pupil may solve'. Assessment by points on test and teaching sheets was the teacher's dilemma towards motivation of the pupils. The teacher had the possibility to reduce criteria of grading. She regarded that issue as a sword with double edged blades (that can turn out either way). There was a dilemma about how she could develop realistic self-evaluation, self-criticism and self- awareness of the pupils if the criteria are reduced.

Another dilemma of the teacher was on teaching methods. She questioned herself whether certain method used was good enough to motivate the pupils.

Lastly, the teacher's dilemma was about the teaching plan and program. The teacher's dilemma was in deciding which contents could be connected and how long to teach them.

To arrive at the solutions to the dilemmas, the teacher used her experience, intuition, trial and fail method, willingness and the need for investigation and searching for solution. She also added that self-reflection helps to get solutions without which 'there is no quality'. The teacher described self-reflection as process of refining. Self-reflections helped the teacher to see what she did or did not do well and in that way avoid making the same mistake again. 'Getting to know the class' was especially helpful to the teacher in arriving at possible solutions to the dilemmas. The feedback from the pupils and knowing which activities they liked or disliked made her decision easier.

4.2.2 Problems and How They Were Confronted

Table 18: Overview of Expressed Problems and Solutions to the Problems

Problems	Solutions to the problems
Classroom position	appointments with parents
School bell	
Not enough time provided by legislative for met individual educational needs of pupils	organized extra teaching lesson more than it was provided
Not enough mathematics lessons per week provided by legislative - many contents	using teaching sheets and giving more homework than she would, parents' involvement, flexible time table and correlation between subjects
Reform of education Inclusive education Pupils' records and Class Diary No standard for finally recording of assessment Role of Supervisor Needs for Association of teachers or an Centre Degraded and neglected of profession from society Needs for stronger Primary Teachers Trade Union	Helped: experiences, love toward pupils, devotion toward occupation and correctness in work.

The teacher didn't consider the class or the pupils as problems. Thus, she said: 'All of us learn differently and in different speed and par se I don't see it as problem'. The teacher emphasized that there could be a problem if a pupil cried or felt unhappy, if parents reacted aggressively and if a pupil was afraid to ask her something, but not if a pupil didn't acquire knowledge. These did not happen in the third grade. According to the teacher it would be direction for her to have to work on it, but not see it as problematic. However, the teacher added that prevention from the beginning was a crucial point and that it is possible that a difficulty turn into problems if there is no prevention, as well as if difficulties get out of control. The teacher regarded following problems toward frame factors and system of education in general:

- Cooperation with parents was much better in previous two school's year. The classroom was situated on the last floor and parents were not free to stay in front of the classroom and in the hall where they could read notice board because 'that is itself a violation of the school rules'. The teacher overcame this problem by making appointments with parents after class day.
- The pupils didn't follow the school bell and they didn't have to 'jump' from subject to subject in lower grades. However, in higher grades it may make them problems because they will have to respect 45-minutes organization of teaching lessons.

- The law provided only one lesson per week for individual teaching or supplementary instruction what was not enough time for meting individual educational needs of pupils. The teacher said that ethics doesn't allow her to leave pupils to themselves and she organized extra teaching lessons more than it is provided by authorities.
- Only three lessons for mathematics per week were provided by law. It was not enough time for teaching-learning of this subject. The contents were so much. They contained all four basic mathematical operation and also geometry contents and measures. There was need for one more lesson per week. Instead that the teacher revised and practised contents 2 lessons, now she had opportunity for it only 1 lesson. The teacher overcame this problem through the use of teaching sheets and giving more homework than she would. This showed the importance of parents' involvement in pupils learning. A flexible time table and correlation of subjects helped the teacher to overcome this problem too.
- Reform of education is a long process and the teacher was aware of it. However, that process brought difficulties because it is going on year by year and the teacher didn't have insight on what pupils will learn in next school years. The teacher's opinion was that it had to be a Pilot project before implementation in all schools.
- The Reform process also didn't bring inclusive education in the forms expected by the teacher. Created professional special teams didn't start to operate well and teachers were minimally helped by them. 'A teacher is initiator of everything and taking on her/his too big responsibility' said teacher.
- Pupils' report cards and Class Diary were not adequate because there was too little space where a teacher had to write what s/he assessed. There wasn't a standard for final recording of pupils' acquired education in the end of the grades or in teacher's words: 'I don't need model (stereotype) because each pupils are different. However, there have to exist some guidelines and standards'.
- Pedagogical Institute Supervisor[41] should be someone who connects teachers, schools, and not someone who only evaluates teaching work based on just 1 watched lesson

[41] General responsibilities of Pedagogical Institutes include: advising on curricula issues, analyzing grading and successful completion of coursework, evaluating educational facilities, advising on the appointment of teachers by assessing and confirming relevancy of qualifications, providing professional development opportunities for teachers and organizing in-service training courses, evaluating school development plans (The OSCE Mission to BiH 2007).

because ‘No one should evaluate someone in one lesson, especially not this kind of work’. The supervisor should be someone who may be helpful, gathers teachers and provides professional help. There was need for Association of teachers and an educational Centre in which teachers could exchange ideas and experiences, as well as share problems.

- Teachers are degraded and neglected from the society. They have got minimal means of payment for their work. Teachers don’t only work at school, but also at home when they prepare for lessons and even on the street when they meet parents. A teacher doesn’t work only 40 hours as it is required. There is a need for a stronger Primary Teachers’ Trade Union which will be able to fight for teachers’ better position in society.

The teacher confronted those stated problems through her: experiences, love toward pupils, devotion toward occupation and correctness in work.

4.3 Summary

Findings of analysed data in chapter 4 were presented through 10 arenas of the modified CRM. Each of arenas consisted of sub-arenas of presentation excepted arena named Peer Support. Study on the first research questions concerned itself 59 findings (Appendix 24). Many aspects have been identified as individually adapted education. In the process of teaching mathematics, the teacher met some challenges which considered as dilemmas and problems. The teacher attempted to solve them in different ways. A discussion of presented findings in their interconnection and correlations with theoretical framework and background information are main focus of the next chapter.

CHAPTER 5: Disscussion, Conclusion and Recommendations

Introduction

Chapter 5 comprises three parts. The first part discusses the major findings in relation to relevant literature cited in chapter 2 and in connection with some background information to the study. The second part presents the summary and some of the conclusions derived from the findings, while the third part contains some reflections and suggestions for possible actions by relevant stakeholders and for future research. These recommendations were made in the light of the findings and conclusions of the present study.

5.1 Disscussion

The findings presented in chapter 4 are categorized and discussed according to the main arenas of the modified Curriculum Relational Model which was described earlier in Chapter 2 and Chapter 3. Although the arenas are presented independently, they are also inter connected to each other. Since this study focused on the adaptation of mathematics' lessons to the diversity of learners, it was found necessary to start the discussion with how the pupils in the class differ.

5.1.1 Pupil(s) Diversity and Assessment

In order to see how the teacher addressed differences in the mathematical lessons, the background information of the pupils in the class was obtained. The findings showed that pupils were different in several aspects like socio-economic background, ethnicity, religion and their learning styles. Some of the pupils were slow or faster than their peers. In the face of challenges, the teacher expressed dilemmas on how to teach pupils who were slower or faster than others. The teacher therefore adopted the strategy of identifying each learner's needs so that she could adapt her instruction accordingly. The findings from the present study disclosed that the teacher did not view the pupils'

difficulties as problems, but rather as pointers to the directions in which she should work. This is in line with the claim of individual adapted educational approach that although difficulties exist among pupils in the educational systems, the system must be adapted to the educational needs of each pupil instead of the discipline-oriented education, where by pupils are seen as problems and they have to change to fit into the system (Cerić & Alić 2005; Johnsen 2001; EENET 1998).

The findings revealed that the main purpose for which the teacher conducted assessment was to get to know pupils' background and to identify their educational needs. This is in agreement with Johnsen (2001) who also suggested that assessment helps teachers to get to know their pupils. So, one of the prerequisites to teach pupils mathematics is to determine their actual levels, i.e. what the individual pupil has already mastered and achieved and is able to do alone as it is defined by Vygotsky (1978).

Regarding methods used for assessment, the findings showed that the assessment methods employed by the teacher included observations, assessment of pupils' work, assessment of group, looking into pupils' files, letters and diaries and talking with parents as well as self assessment by learners themselves. These methods are in line with the methods of assessment suggested by Johnsen (2001, 2003 & 2007), Ornstein (1995) and Westwood (2004). The teachers' assessment focussed on pupils from both contextual and ecological aspects as emphasised by Bigge et al. (1999) and Johnsen (2001 & 2003). Thus, through talking with parents after knowing pupils from school, the teacher was able to get a broader knowledge of her learners at the different micro, meso, exo and macro levels as illustrated by Roggof (2003) and in Brenfenbrenner's (1979) theory of ecology of human development.

The teacher not only assessed pupils but also her own work in order to seek solutions to some of the dilemmas that arose during the mathematical lessons. Westwood (2004) and Bigge et al. (1999) emphasised program reviews as important aspects of assessment. The teacher, however, expressed difficulties in recording information from assessment since there was no standard guide for recording them into report cards and diaries. The investigator's opinion about this was that the teacher's worry about the absence of

standardised recording guide was a contradiction of the need to assess pupils according to their different needs. The findings further indicated that the teacher used the information obtained by assessment to make important instructional decisions. This is in accordance with a study by Salmon (1996), who found that teachers linked pre-assessment with decisions about instruction. These instructional decisions could lead to the formulation of new or review of intentions as discussed next.

5.1.2 Intentions

Intentions in this study referred to the learning objectives set based on the grade curriculum provided by authorities. The main objective was the acquisition of knowledge about the four basic mathematical operations. The findings showed that the teacher adapted long-term objectives to meet the individual differences among learners. The teacher's view was that pupils should progress according to their individual pace of learning. This view was in line with Johnsen (2001 & 2003) and Noddings (2003) who stressed the need for changing intentions to achieve 'concrete educational actions within the framework of existing policy' (Johnsen 2001, p. 259).

5.1.3 Content

In this study content referred to the mathematics syllabus that the teacher followed as prescribed by law. According to the BiH laws, teachers have some level of freedom and autonomy to adapt their lessons but they should keep to the standards set (FL 2003, Art. 41; LP 2004, Art. 43). The present study revealed that the teacher was guided by the curriculum on what to teach and this made her to spend time on deciding how to teach. The same finding is also citied in a study by Salmon (1996).

The findings further revealed that the teacher adapted the teaching plan to class conditions and therefore spent more time on teaching certain contents. This helped to bridge the gap between the official curriculum and the actual situations in the class as it was emphasised by Johnsen (2001). It also emerged from the findings that the teacher was concerned that the three lessons per week for mathematics provided in the grade curriculum were not adequate for completing the entire mathematics content. The

teacher also met problem about which content will be teach in the next grades. This problem came from the reform of education which is done annually.

In order to make contents more familiar to pupils, the teacher adapted teaching by connecting mathematical concepts to daily life situations and other subjects. Similarly, Bigge et al. (1999) and NCTM (2008) emphasised that pupils should experience those connections and understand that ideas in different areas are related. The teacher did these through role plays and rule games. This is in line with Bognar and Matijević (1993) who indicated that games ensure a rich experience and full engagement in activity. Connection of mathematical content was also one of the ways which helped the teacher to overcome the problem met in the teaching plan and program.

Teaching Strategies

In this study teaching strategies referred to procedures followed to attain a goal (Lipovac & Vukobratović 2002; Ostad 2001). They included teaching methods, peer support, classroom organisation and teaching materials. The findings showed that the teacher used different strategies in every lesson. This was in line with differentiation approaches which aim to meet pupils' educational needs by applying a variety of instructional strategies (Ivory 2007; Norwich 1994; Tomlinson 1995; Westwood 2004). Tomlinson (1995) also stressed that there is no recipe for differentiation and therefore teachers can vary their strategies in many ways depending on the needs of learners.

5.1.4 Teaching Methods

The study showed that the teacher used a variety of teaching methods. The teaching methods used by the teacher included dialogue method which was based on the principle of question-answer, demonstration, learning through discovery of errors and problem teaching. In order to address the needs of pupils with difficulties in mathematics, the teacher applied individualised teaching. A study conducted in Britain in 1993 across 128 schools showed that the best achievement of learners was in classes where teachers used a multiplicity of methods (Westwood 2004). In the present study, the methods used by the teacher seemed to be based on the principle of scaffolding

(Holton and Clarke 2006) and direct engagement in tasks. Expert scaffolding by the teacher (Holton and Clarke 2006) was based on the principle of question-answer. Findings about teaching methods are also in line with findings of a study of a project named Effective Teachers of Numeracy (Askew 2000 & 2001). This study showed that highly effective teachers used so-called connection orientation.

5.1.5 Peer Support

The study found that pupils supported each other on the teacher initiative and also voluntarily during joint class activities. According to Vygotsky's theory of cognitive development, learning is a result of interaction between pupils and more capable peers (Vygotsky 1978). Rogoff (1990) also stated that through cooperation, pupils became their own teachers in the process of guided participation and shared understanding of activities. During the teaching learning process, there were two types of scaffolding, namely expert scaffolding in which one pupil guided other pupils and reciprocal scaffolding during which pupils worked together to solve tasks and exchanged the role of an expert (Holton and Clarke 2006).

5.1.6 Classroom Organisation

The study found that the teacher used a whole class approach in order to be able to give information to the entire class and carry out group assessment when necessary. It was also found that the teacher differentiated group work tasks implying that pupils would work together to produce the same outcomes, but also worked on same tasks and produced different outcomes and different tasks with similar outcomes. Similar forms of differentiation used by the teacher were also emphasised by Dunne and Bennet 1990 (in Alexander 2000). Pupils' independent work on text materials were primarily used for assessment. Bugnar and Martijević (1993) stressed the importance of balance in the classroom organisation in order to meet pupils' needs for individualised support and socialisation, as well as the need for exchange of activity in which the teacher worked with whole class and pupils worked independently.

5.1.7 Teaching Materials

The findings regarding the types of materials showed that teaching sheets were the most common materials used while the text books were seldom used. According to the teacher, she preferred teaching sheets because they were more appropriate for meeting pupils' needs. The teaching sheets used for assessment were the same for all pupils unlike those used for group work which were different. However, the teacher seemed to be undecided about whether to use the same or different teaching sheets to assess pupils who were slower than other pupils. During the feedback regarding assessment results, the teacher tried to be sensitive to pupils' feelings which indicated an element of the sense of care for pupils' emotional needs. In addition to using objects as materials, the teacher also used body movements and pupils' fingers during role-plays of daily-life situations. Liebeck (1984 & 1995) emphasised the importance of hands-on activities in helping pupils to learn from concrete to abstract. Similarly, Lett (2007) stated that hands-on activities were interesting and made mathematics lessons more enjoyable for pupils. The findings of the present study about teaching materials are compared with findings of a study by Marlow and Inman (1997) in Table 19 below:

Table 19: Comparison of Findings about Teaching Materials

	Study by Melow and Irman	Present study
Textbook	Used by 60 % of teachers	used very rare
Other teaching materials	calculators, geometrics' models, fraction rods and tangrams.	Texts materials, games, objects, body and fingers as medium
Barriers	lack of appropriate teaching materials, low parental expectations, management and discipline problems, planning and preparation requirements	didn't exist

5.1.8 Communication and Care

The study tried to investigate whether the teacher demonstrated a sense of care for pupils' emotional and psychological needs during the teaching learning process. The findings showed that the teacher demonstrated care in various ways. Thus, the teacher created a positive atmosphere for learning and she was interested and responsible for learners' emotional as well as physical needs. In doing so, she praised pupils, allowed them to express themselves freely but also paid attention to their discipline. The

teacher's sense of care seems to correspond to some of the themes on quality interaction and mediation of the ICDP (Rye 2001 & 2005). Thus by caring for pupils' emotional needs, the teacher created an effective socio-emotional climate where each child would feel secure, be seen, heard, noticed, met, understood, acknowledged, respected and loved (Rye 2001 & 2005). According to Rye (2001 & 2005), such a climate is the foundation necessary for mental development. Pupils also learn to care not only for themselves but also for others, the environment, objects and ideas (Noddings 2005).

5.1.9 Other Topics

As provided in the curriculum, the teacher conducted extra teaching lessons once a week in order to address the educational needs of some pupils who might not have understood certain aspects in the ordinary mathematics lessons. In addition, she organised extra teaching in continuum once a week in a semester. According to the teacher, the reason for organising more extra teaching lessons was that only one lesson a week was thought to be insufficient to address the learning needs of different pupils. Similar to extra teaching, the teacher also organised out of school activities which were emphasised by Schwarz (1999) who claimed that out of school activities can improve pupils' understanding of mathematics vocabulary. Nicol and Crespo (2005) also suggested that out of school activities provide meaningful learning opportunities for mathematics.

5.1.10 Frame Factors

The study of frame factors indicated that the teacher was continuously in-service educated and that she loved children and her profession of teaching. Zečić and Jeina (2006) emphasised the need for in-service education in helping teachers in their continuous development of professional competences. However, findings showed that the teacher was dissatisfied with the teaching profession and her position as teacher mainly because in her view, teachers are not respected in the society. Her view is in agreement with Radeka and Sorić (2006) who found out that although teachers were happy with their profession, they were discontented with the working conditions and very concerned about the low living standards and teachers' bad reputation in society.

The study also found that parents were involved in the teaching –learning process and they collaborated with the teacher by assisting pupils to complete their homework. According to Balli (1998), parents' participation in pupils' homework can improve pupils' achievement in mathematics. On the contrary, Bal and Goc (1999) found that increasing parents' participation did not result in improved pupils' achievements in mathematics lessons. In the present study, the teacher appeared to have problems with meeting parents because the classroom was situated up on the last floor where parents could not access easily. To overcome this barrier, the teacher would make appointments with parents outside class hours. Besides cooperating with parents, the teacher also worked with fellow teachers (e.g. in lesson preparation). Bognar and Matijević (1993) emphasised the advantage of teamwork in giving the possibility of utilising both individual skills and abilities. Teamwork also encouraged teachers to improve teaching and to share useful experiences (Johnsen 2001).

The finding indicated that the teacher used the time table and duration of lessons flexibly with the purpose of meeting pupils' interests and educational needs. This flexibility in realization of lessons is also ensured by BiH legislatives. However, the teacher expressed that it may make problems to pupils because they will have to respect 45-minutes organization of teaching lessons in upper grades. The need for change in frame factors were also mentioned during the project conducted between Norwegian and BiH researchers and other educators (Johnsen 2007). During workshops, participants expressed the need for changing some aspects of existing frame factors. The expressed needs by the case teacher in this study and by participants of the mentioned project have some similarities and differences which are presented in Table 20 below:

Table 20: Comparison of Findings about Challenges in Frame Factors

	Case teacher	Project
Similar	Changing of the school interior; Need for internal teams and more cooperation with external support teams; Need of special needs educators in the school; Upgrading of teachers	
Different	Need for more lessons for mathematics More lessons for extra teaching Change in assessment Change in role of Pedagogical Institutes Need for Association of teachers and educational Centre Change in attitudes of society Need for a stronger Trade Union	Decrease the number of pupils in the class Financial support for materials and equipment Teacher training in coping with stress and burn-out Need for more cooperation with parents

Findings showed that the teacher overcame the challenges through her experiences, love toward pupils, devotion toward occupation and correctness in work, trial and fail method, willingness and the need for investigation and searching for solution, self-reflection and getting to know the class and their educational needs.

5.2 Summary and Conclusion

This study attempted to investigate how the teacher managed to teach mathematics to all pupils with different educational needs, the challenges she met in the process and how they were confronted.

The findings showed that assessment was a crucial pre-requisite for adapting teaching to the diversity of learners. Assessment helped the teacher to gather information about pupils and her own work which she later used to make important decisions about the teaching-learning process. The teacher followed the mathematics curriculum as prescribed by the law and this resulted in the teacher using of time in deciding how to teach. Even though the long-term objectives set by the teacher were the same for all pupils, she thought that pupils should progress at their individual pace of learning. Hence, the teacher adapted teaching plan and program according to the diversity of pupils.

Regarding teaching strategies, the teacher used a variety of methods and differentiated her teaching basing on the diversity of learners. The principle of scaffolding and direct engagement of pupils in class activities was evident in the mathematics lessons. During the lessons, the teacher, group of pupils and individual pupils exchanged guiding rules of teaching and in that way peer support became expressed fully, as well as balancing of classroom organizations. The study found that the dominant teaching materials used by the teacher were teaching sheets while text books were seldom used. In addition to the usual teaching lessons, the teacher also conducted extra teaching with the purpose of giving additional support to some pupils who might not have understood certain aspects of the mathematical lessons. Findings regarding care and communication showed that

the teacher demonstrated a sense of care during mathematical lessons by showing love and interest to learners' emotional and psychological needs.

In general, the study discovered that teaching and learning of mathematics is both a complex and challenging process. The teacher viewed challenges as dilemmas and problems in the process of teaching and learning of mathematics. The findings showed that the teacher expressed dilemmas regarding all aspects of teaching-learning process and found problems within frame factors, but tried her best within her means to solve most of them.

5.3 Reflections and Suggestions

Considering the limitations of this study and based on the findings and conclusions, the following recommendations are proposed for possible actions and for future study:

- This study included only a single case of one teacher and one class[42]; it would be interesting for future studies to repeat the study with other teachers from other classes and schools.
- The study embodied the entire teaching-learning process which was quite huge; it might be useful for future studies to focus on only one or some aspects of the teaching-learning process to obtain more in-depth findings.
- The current reform of the educational system in BiH has proposed an innovate approach based on a broader curriculum approach. The CRM developed by Johnsen is proposed as a possible solution and as a base for planning, practicing and assessment of teaching-learning process in mathematics with special focus on individual adapted education according to the diversity of pupils.

The investigator's hope is that the examples of teaching-learning mathematics presented in this study may be useful to other educators as a motivation to develop their own ideas.

[42] The issue of limitation and questioning in generalization of a single case study is presented in Chapter 3.

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Appendicies

Appendix 1: Dual and Incoporate Systems

Table 21: Dual and Incorporate Systems

	Dual system	Incorporate system
Pupils' characteristics	Pupils are separated in special and ordinary schools based on "normal" or "deviate" characteristics	Respect pupils intellectual, physical and psychological differences
Individualization	For pupils who are labelled as special	For all pupils
Teaching methods	Special methods for special pupils	Appropriate methods according to learning needs of each pupil
Educational service	Dependent upon the categorization of pupils	Dependent upon the pupils' individual needs
Diagnosis	Large expense for categorization of pupils	Emphasis on identification of specific learning needs of all pupils
Professional relationship	Establishing of unnatural barriers between teachers in ordinary and special schools that lead to competition and alienation	Co-operation through the mutual use of resources; helping each other and stimulate responsibility
Curriculum	Contents are limited according to the categorization of pupils	Contents are adapted according to the needs of each pupil
Focus	Pupils are transferred to a special school when they cannot adapt to the curriculum of ordinary schools	Curriculum of ordinary school is adapted according to the needs of all pupils
' Real world'	Some pupils are educated in artificial special world	All pupils are educated in an ordinary school
Attitude	Education is seen as mercy	Education of all pupils is natural and expect practice

Adapted form Stainback and Stainback (in Cerić & Alić 2005, p. 42)

Appendix 2A: Location of Bosnia and Herzegovina

BiH is situated in the heart of south-eastern Europe, on the Balkan Peninsula. The country has a total area of 51.209,2 km^2 (Federal Office of Statistics, BiH, 2008). BiH shares borders with Croatia to the north and west and Serbia and Montenegro to the east.

Photo 1: Location of the Bosnia and Herzegovina

Appendix 2B: Cantons of Federation of Bosnia and Herzegovina

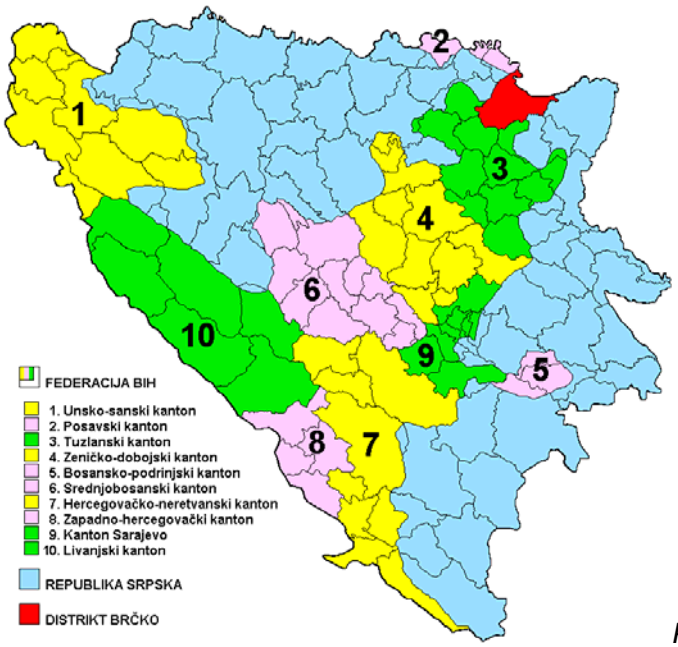


Photo 2: Cantons of Federation of Bosnia and Herzegovina

Appendix 3: Education Levels in Bosnia and Herzegovina

Table 22: Educational System in Bosnia and Herzegovina

Level 0	Pre-school education (Age: 0 – 5 / 6)	
Level 1	'Old' primary	Reformed primary
	Lower primary school (grades 1– 4) Age: 7 – 10	Primary school, cycles 1 and 2 (grades 1-6) Age: 6 - 11
Level 2	Upper primary school (grades 5–8) Age: 11 – 14	Primary school (cycle 3: grades 7–9) Age: 12 - 14
Level 3	Secondary school (grades 1 – 3 / 4) Age: 15 – 17 / 18	
Level 4	Post-secondary, non-tertiary education Duration: 2 years	
Level 5	Higher education - Faculties and Art Academies (BA and MA studies) Duration: BA – 3 / 4 yrs; MA – 2 yrs	
Level 6	PhD Studies (Duration: 3 yrs)	

Pašalić-Kreso et al. (2006, p. 172)

Appendix 4: Institutions and Years of Pre-Service Teachers' Education in BiH

Table 23: Pre-Service Teachers' Education in BiH

Name of the Institution	Years of study
University of Banja Luka, Faculty of Philosophy	4
University of Banja Luka, Faculty of Natural Sciences and Mathematics	4
University of Sarajevo, Faculty of Philosophy	4
University of Sarajevo, Pedagogical Academy	4
University of Sarajevo, Faculty of Natural Sciences and Mathematics	2 and 4
University of East Sarajevo, Faculty of Philosophy	4
University of Tuzla, Faculty of Philosophy	4
University of Tuzla, Faculty of Education and Rehabilitation	4
University of Tuzla, Faculty of Natural Sciences and Mathematics	4
University of Zenica, Faculty of Pedagogy	2 and 4
University of Zenica, Islamic Pedagogical Academy	2
University of Bihac, Faculty of Pedagogy	2 and 4
University of Bihac, Islamic Pedagogic Academy	2
University «Dzemal Bijedic» Mostar, Pedagogic Academy	2
University of Mostar, Faculty of Pedagogy	4
Teacher Training College Bijeljina	4

Pašalić-Kreso et al. (2006, p. 176)

Appendix 5: Teaching Plans for Lower Grades of Nine-Year Primary School

Table 24: Teaching Plans for Lower Grades of Primary School

NO	Obligate teaching subjects	First grade		Second grade		Third grade		Fourth grade	
		Per week	Per year	Per week	Per year	Per week	Per year	Per week	Per year
1.	Bosnian, Croatian and Serbian Language and Literature	3	102	4	140	4	140	5	175
2.	Mathematics	2	68	3	105	3	105	4	140
3.	My Environment (science)	2	68	3	105	3	105	3	105
4.	Music Culture	2	68	2	70	2	70	2	70
5.	Art Culture	2	68	2	70	2	70	2	70
6.	Body and Health Education (sport)	2	68	2	70	2	70	2	70
7.	Foreign Language	-	-	-	-	2	70	3	105
	TOTAL:	**13**	**442**	**16**	**560**	**18**	**630**	**21**	**735**
8.	Religious Teaching	1	34	1	35	1	35	According to Cantonal Low	
9.	Facultative Subject	-	-	-	-	-	-	1	35
10.	Class Meeting	-	-	-	-	-	-	1	35
	After School Activities	According to programme and pupils' interests						1	35
	Extra Teaching Programme	According to needs / where applicable						-	-

The Ministry of Education and Science of Canton Sarajevo (2005, p. 4); Governing Body for Preparation of Prepositions of Passage Strategy on Obligate Nine – Year Primary Education in Federation of Bosnia and Herzegovina (2006, p. 4)

Appendix 6: Curriculum Relation Model

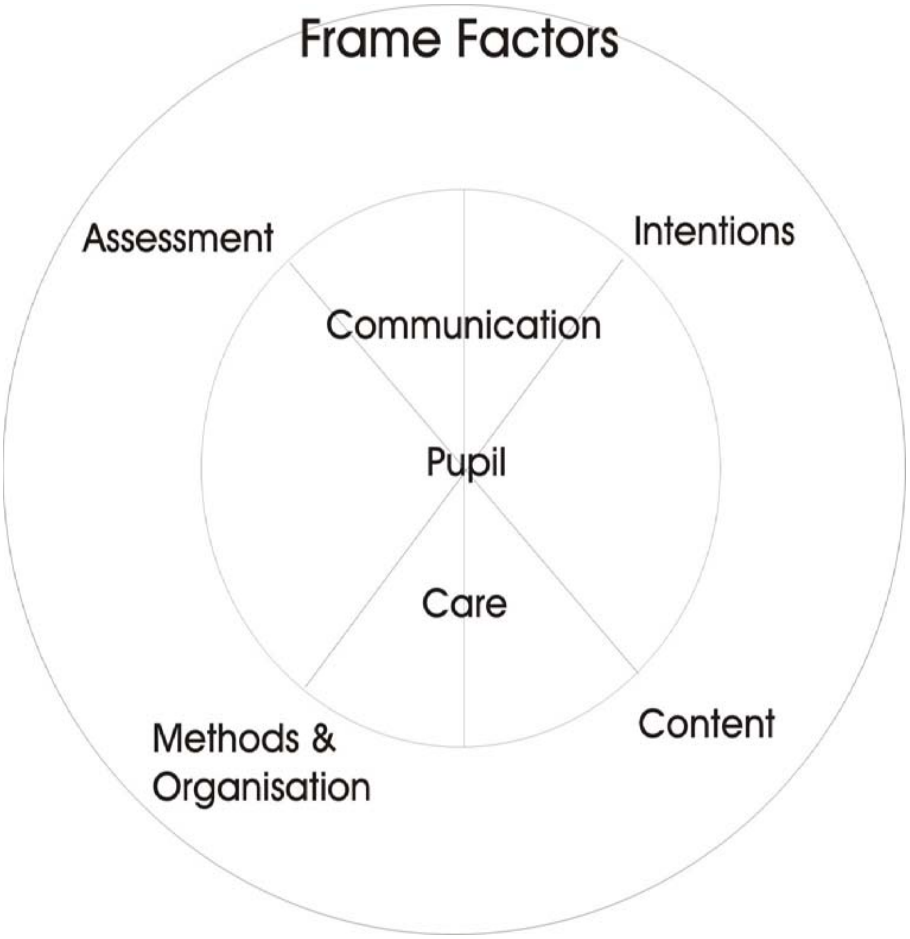


Figure 4: Curriculum Relation Model with some Important Aspects of Teaching and Learning Processes (Johnsen 2007, p.342)

Appendix 7: Summury of Data Collection Procedure

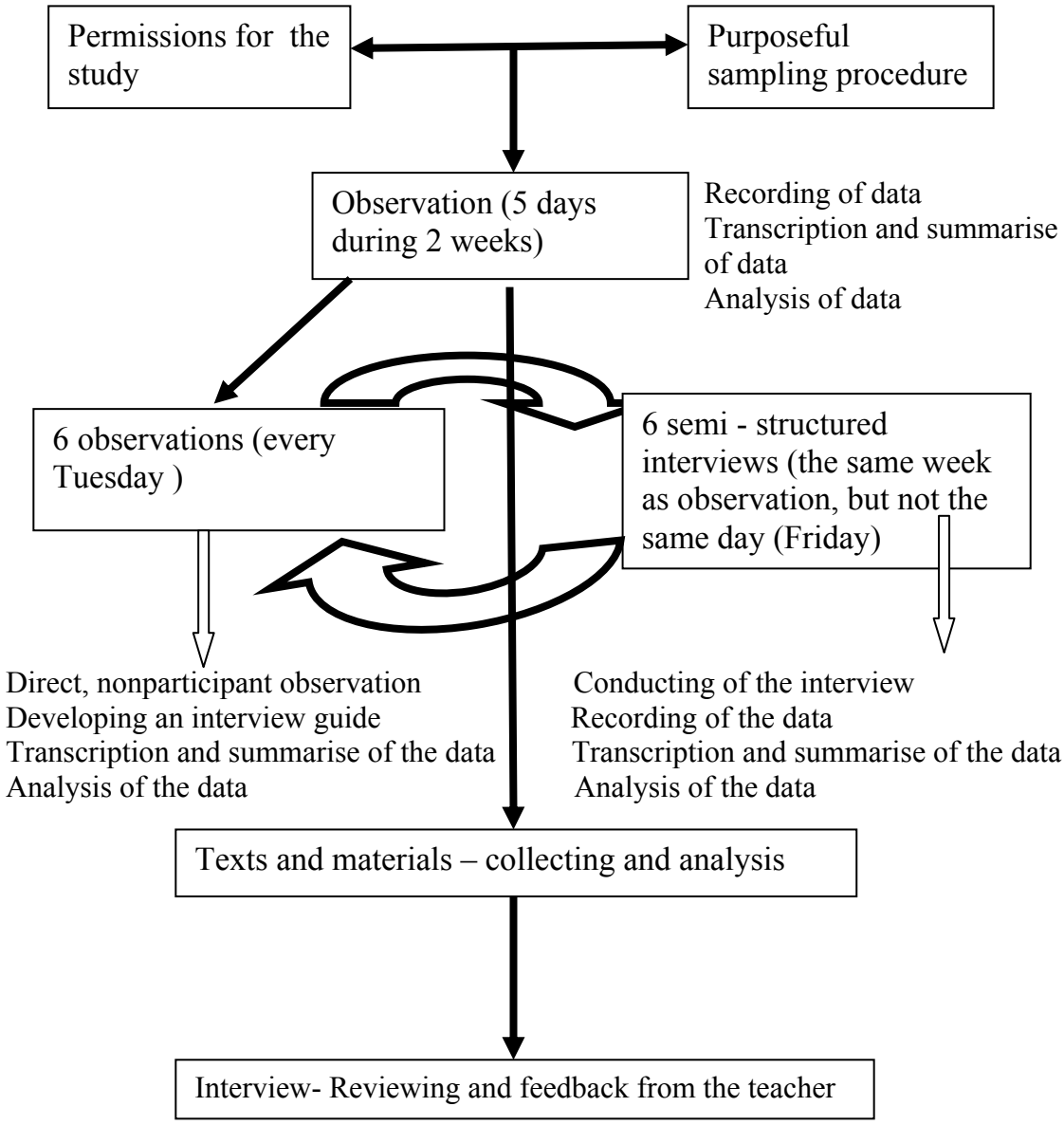


Figure 5: Graphical Presentation of the Data Collection Procedures

Appendix 8: Permission from the Ministry of Education and Science

Bosna i Hercegovina
Federacija Bosne i Hercegovine
KANTON SARAJEVO
Ministarstvo obrazovanja i nauke

Bosnia and Herzegovina
Federation of Bosnia and Herzegovina
CANTON SARAJEVO
Ministry of Education and Science

Broj: 11-04-38-18777/2007
Sarajevo, 14.08.2007. godine

ABDULOVIĆ AIDA
Sarajevo, Olovska br. 20

PREDMET: Saglasnost za sprovođenje istraživanja

Nakon što smo proučili Vašu Molbu od 05.07.2007. godine, a koja se odnosi na izdavanje dopuštenja za sprovođenje pedagoškog istraživanja u OŠ « [redacted] po uobičajenoj proceduri istu smo proslijedili na stručno mišljenje Prosvjetno-pedagoškom zavodu.

Cijeneći dobijeno Mišljenje, saglasan sam da se traženo istraživanje u cijelosti provede na predloženi način.

S poštovanjem,

MINISTAR
Mr. Safet Kešo

e-mail: monks@ks.gov.ba, www.monks.ba
Tel: + 387 (0) 33 562-128, Fax: + 387 (0) 33 562-218
Sarajevo, Reisa Džemaludina Čauševića 1

Appendix 9: Permision from the School

Bosna i Hercegovina
Federacija Bosne i Hercegovine
Kanton Sarajevo
Općina Novi Grad
JU OŠ
Sarajevo

S a r a j e v o, 25.9.2007.
Broj : 440-01 /2007.

Na osnovu člana 96. Pravila JU OŠ « " SARAJEVO i molbe Aide Abdulović za izdavanje dopuštenja za sprovođenje istraživanja, direktorica škole donosi

O D L U K U

1. Odobrava se pedagoško istraživanje Aidi Abdulović, profesorici razredne nastave, u periodu od septembra 2007.god. do janura 2008.god.

2. Pedagoško istraživanje imenovana će sprovesti u odjeljenju.

O b r a z l o ž e n j e

Dana, 25.9.2007.god., direktorici Škole se obratila Aida Abdulović, profesorica razredne nastave, sa molbom da u Školi izvrši pedagoško istraživanje, koje sprovodi u okviru magistarskog studija, Odsjeka za odgoj i obrazovanje djece sa posebnim obrazovnim potrebama, pri Univerzitetu u Oslu (Norveška). Istraživanje se odnosi na podučavanje i učenje u nastavi matematike sa ciljem otkrivanja kako nastavnik razredne nastave uspijeva podučavati matematiku učenike koji imaju različit nivo znanja, na koje poteškoće nailazi pri tome i kako ih prevazilazi.
Imajući u vidu gore navedeno direktorica škole je postupila kao u dispozitivu.
Protiv ove Odluke može se uložiti prigovor Školskom odboru u roku od 8 dana od dana prijema.

Dostaviti:
1. Imenovanoj
2. A/a

Direktorica:

Appendix 10: Research Participant Consent Form (teacher)

Research Participant Consent Form

This form is to indicate your consent to:

1. Participate in the study: **Teaching – Learning Mathematics: A Base Line Study of Individual Adaptation in Mathematics Class According to the Diversity of Learners in an Third Grade of Primary School in Canton of Sarajevo, BiH**
2. Have the information from the observations, texts and materials analysis, and the interview that you participate and which will be recorded on a video and voice recorders and included in the results of the study.

The results and materials from the observation, texts and materials analysis, and the interviews may be included in Master thesis, written reports, a written book, a book chapter, journal articles, conference papers and/or policy recommendations and training material. Only pseudonyms will be used when discussing or writing up the information you offer. A copy of this informed consent will be given to you.

TO EXPRESS YOUR CONSENT PLEASE READ AND SIGN BELOW:
I, the undersigned, have read the information sheet. I have had an opportunity to discuss any queries with the investigator. I hereby consent to being involved in the following study activities:
OBSERVATION, INTERVIEW, TEXTS AND MATERIAL ANALYSIS
And
I hereby consent to have the information from the observation, texts and material analysis, and the interview used as part of this study.

NAME OF PARTICIPANT: ……

ROLE IN ORGANISATION: ……

PHONE: ……

ADDRESS: .....

SIGNATURE: ……...

Appendix 11: Informative Letter with Consent Form (parents)

Aida Abdulović,
studentica na Magistarskom studiju
Univerziteta u Oslu, Norveška
Olovska 20, Sarajevo, BiH
Telefon: 061 83 58 66
E-mail: aidaa@student.uv.uio.no

Poštovani roditelji/staratelji,

Zovem se Aida Abdulović i nalazim se trenutno na Magistarskom studiju u okviru Odsjeka za odgoj i obrazovanja posebnih obrazovnih potreba, kojeg pohađam pri Univerzitetu u Oslu (Norveška). Naime, nakon uspješno završene prve godine studija, obevezna sam izvršiti pedagoško istraživanje u svojoj zemlji, te rezultate predstaviti u magistarskom radu.

To je istraživanje o podučavanju i učenju u nastavi matematike sa ciljem otkrivanja kako učitelj razredne nastve uspijeva podučavati matematiku svu djecu sa različitim nivoima znanja, na koje poteškoće nailazi u tom procesu i kako ih prevazilazi.

Kvalitetno i potpuno sprovođenje ovog pedagoškog istraživanja predviđa **posmatranje** izvođenja nastavnih časova matematike, kao i **uvid** u materijale koje učenici koristite u svom radu. S obzirom da istraživanje uključuje **video snimanje** nastavnog časa, a da su učenici maloljeni, potrebna je vaša saglasnost o sprovođenju ovakvog istarživanja.

Sve informacije koje budu prikljuplje koristiće se isljučivo za potrebe istraživanja i biće pouzdano čuvane. Ukoliko se slažete da Vaše dijete učestvujete u ovom istraživanju, molim Vas da pročitate i potpišete Formu o odobrenju učesnika istraživanja.

Za sva dodatna pitanja molim Vas da me kontaktirate na navedeni broj telefona ili putem elektronske pošte.

Unaprijed vam se zahvaljujem na pomoći.

Sarajevo, Septembar, 2007.god. Student: Aida Abdulović

Odobrenje roditelja/staratelja

Ja ……. (ime i prezime roditelja/staratelja) dajem odobrenje da moje dijete ……..(ime i prezime djeteta) u svrhu pedagoškog istraživanja može biti : posmatrano i DA NE

video snimano DA NE

Potpis roditelja/ staratelja :……

Datum: _____

Appendix 12: Letter from the University of Oslo

UNIVERSITY OF OSLO

Department of Special Needs Education

P.O.Box 1140, Blindern
N-0318 Oslo
NORWAY

Visiting address:
Helga Eng's Building
3rd and 4th floor

Telephone: + 47 22 85 80 59
Telefax: + 47 22 85 80 21

FACULTY OF EDUCATION

Your ref:
Our ref: 13/07 ST/db
Contact person: Denese Brittain d.a.brittain@isp.uio.no

Date: June 4. 2007

TO WHOM IT MAY CONCERN:

This is to certify that **ABDULOVIĆ, Aida** date of birth 04.06.1970, is a full-time student pursuing a course of study at the Department of Special Needs Education at the University of Oslo, Norway, leading to the degree of Master of Philosophy in Special Needs Education (M. Phil. SNE).

This is a continuous two-year programme run on the "sandwich" principle, which involves periods of study and field work/research in both Norway and the home country. The student has concluded the initial 11-month period in Norway and will be returning to the home country in July 2007 to continue full-time studies/research until 1 January 2008 when s/he returns to Norway for the final part of the degree. The period of study will be completed at the end of May 2008.

The main responsibility for supervising the research, developmental work and thesis remains with the Department of Special Needs Education, University of Oslo, Norway. However, we would kindly request that the relevant authorities give the student the access required to the schools and educational establishments necessary in order to undertake field work and research. We would also be most grateful for any assistance that is afforded to the student which enables her/him to carry out this work, particularly the use of facilities such as access to telephone, fax, e-mail, computer services and libraries at the various educational establishments.

Yours sincerely

Ass. Professor Steinar Theie
Academic Head of International Master's Programme
Department of Special Needs Education

Department of Special Needs Education
Faculty of Education
University of Oslo, Norway

Institutt for spesialpedagogikk
Det utdanningsvitenskapelige fakultet
Universitetet i Oslo
Norge

Appendix 13: Observed Lessons

Table 25: Observed Lessons

	Teaching lessons	Types	Lasting of lessons
1	Addition of two digit and one digit numbers with carrying (form 25 +7)	learning of new content	62 minutes
2	Addition of two digits and one digit numbers with carrying	review and practice	54 minutes & 30 seconds
3	Subtraction of one digit number from two digit number with borrowing (form 34-8)	learning of new contents	44 minutes & 30 seconds
4	Subtraction of one digit number from two digit number	review and practice	62 minutes & 30 seconds
5	Addition and subtraction of numbers	review and practice	67 minutes
6	Addition and subtraction of two digit numbers without carrying and borrowing (forms 23 + 34 and 79 – 25)	learning of new content	73 minutes
7	Addition of two digits numbers with carrying	review and practice	40 minutes & 15 seconds
8	Equations with addition and subtraction	learning of new content	50 minutes & 20 seconds
9	O 9 – Inequality with addition and subtraction	learning of new content	57 minutes % 10 seconds
10	O 10 – Addition and subtraction	review and practice	62 minutes
11	O 11 – Addition and subtraction	evaluation	30 minutes & 20 seconds

Appendix 14: Observation Guide Form

<table>
<tr><td>Pupils</td><td>Frame factors</td><td>Intentions</td><td>Content</td><td colspan="2">Teaching strategies</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Methods</td><td>Organization</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Teaching strategies</td><td>Assessment</td><td>Communication</td><td>Care</td><td>Other topic</td></tr>
<tr><td>Materials</td><td>Peer support</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td></td><td></td></tr>
</table>

* Original Observation Guide Form was on A3 format of paper

Appendix 15: Semi-Stuctured Interview Guide

	Bosnian, Croatian, Serbian language	English language
Učenik-učenici /Pupil(s)	Kako odlučuješ koje dijete će dati odgovor?	How do you make decision about who will give the answer on your question?
	Šta misliš o računanju na prste?	What are you thinking about calculation on fingers?
	U razredu je dijete manjinskog naroda. Kako gledaš na to?	There is a pupil in the class who belongs to the minority of BiH nations. What are you view on it?
	Primjećujes da se dijete neobično ponaša. Kako to doživljavaš?	You noticed that pupils behave differently than usual. How do you experience it?
	Koji se učenici smatraju da imaju poteskoće u nastavi matematike? Ko ih je identifikovao?	Who are the pupils who have difficulties in mathematics? Who identifies the pupils with difficulties?
Okvirni faktori/ Frame factors	Podaci o učiteljici	Background information about the teacher
	Podaci o odjeljenju	Background information about the class
	Šta misliš o svom pozivu? Kako vidiš svoj posao u društvu?	What is your opinion about your occupation? What is you opinion about the status of teaching occupation in the society?
	Kako si podržana od škole u svom radu?	How does the school support you in your work?
	Ko učenicima nabavlja udžbenike i školski pribor?	Who acquire textbooks and equipments for pupils?
	Kako si zadovoljna nastavnim sredstvima koje imaš u razredu?	How satisfied are you with teaching aids and materials you have in classroom?
	Kako dolaziš do didaktičkog materijala?	How do you acquire didactical materials?
	Učionicu djijeliš sa još jednim razredom. Možes li mi nešto malo više reći o tome?	You share the classroom with the class in opposite shift. Can you tell me a little bit more about it?
	Primjetila sam da ni ti ni djeca ne obraćate pažnju na školsko zvono. Možes li mi nešto malo više reći o tome?	I have noticed that both pupils and you didn't paid attention on school bell. Can you tell me little a bit more about it?
	Ko određuje koji ćes čas držati i koliko?	Who determinates which lesson you will teach and how long?
	Sad imamo reformu školstva koja je donijela niz promjena. Kako ti gledaš na te promjene?	Now, we have Reform of education which has brought a chain of changes. How do you look on it?
	Kako se to odrazilo na matematiku?	How does it reflect on mathematics?

	Koja je uloga roditelja u dječijem učenju?	Which roles do parents have in child's learning?
	Kako roditelj može pomoći djetetu u učenju matematike?	How can a parent help his/her child in learning of mathematics?
Procjenjivanje/ Assessment	Kako upoznaješ djecu?	How are you getting to know pupils?
	Šta te interesuje kod djeteta?	What is your focus on?
	Često radiš procjenu učenika. Zašto?	You often assess pupils. Why?
	Šta misliš o ocjenjivanju učenika?	What is your opinion about evaluation of pupils?
	Na početku časa ponavljaš gradivo. Zašto?	You revise contents at the beginning of the lessons. Why?
	Šta radis sa nastavnim listićima kad ih učenici vrate?	What do you do with teaching sheets when the pupils bring them back?
	Učenici se ne ocjenjuju brojčano, ali su na kontrolnom radu imali poene. Reci mi malo više o tome.	Pupils are not graded numerically, but on the test there were points. Tell me little bit more about it.
	Kako ti procjenjuješ svoj rad?	How do you assess you own work?
	Kako se pripremaš za čas? Šta uzimaš u obzir?	How do you prepare for the lessons? What do you take into consideration?
Ciljevi i sadržaji / Intentions and contents	Zakon predviđa slobodu u kreiranju nastave. Ima li učitelj potpunu slobodu u kreiranju svog rada u nastavi matematike?	Legislative predicted teachers' freedom in designing of the lessons. Is teacher totally free to crate own work in mathematics?
	Kako uspjevaš pomiriti svoju slobodu i član zakona koji kaže da se gradivo koje je predvideno planom i programom mora realizovati?	How do you manage to reconcile you freedom and Article which stressed that content should be realized according to the curriculum?
	Na osnovu čega postavljaš cilj časa?	How do you determinate intentions?
	Šta je najbitnije da djeca znaju iz matematike?	What is the most important of what the pupils know in mathematics?
	Mozeš li mi nešto reći o sadržajima koji učenici trebaju savladati u 3. razredu.	Would you tell me something about content pupils have to acquire in the third grade?
	Koliko su sadržaji koje djeca uče relevantni za svakodnevni život?	How relevant is the content which pupils learn for daily life?
	Koliko su sadžaji matematike odgovarajući za učeničko razumjevanje?	How much do the contents fit pupils' understanding?
	Koristiš li matematičke sadržaje u drugim predmetima? Za šta?	Do you use mathematical content in other subjects? For what?
	Kako matematiku približavas učeničkom ličnom iskustvu?	How do you apply mathematics to the pupils' own experiences?

Nastavne strategije /Teaching strategies	Koje metode rada su ti se pokazale najefikasnije u nastavi matematike?	Which teachings methods have showed to be the most effective in mathematics?
	Učenici dolaze do rješenja i usmeno, bez zapisivanja. Šta time postižes?	Pupils solve problems also orally, without writing. What do you attain with it?
	Insistiras na određenom postupku pri računanju. Zašto?	You insist on a particular way of calculation. Why?
	Kako motivišeš učenike za učenje matematike?	How do you motivate the pupils for learning of mathematics?
	Zašto učenici na početku časa obično sjede na tepihu u krugu?	Why do pupils often sit in the circle on the carpet at the beginning of the lessons?
	Kako formiras grupe? Na osnovu čega? Od čega to zavisi?	How do you form groups? According to what? On what does it depend?
	Grupe na nastavnim listićima trebaju nacrtati znak ili napisati ime svoje grupe. Zašto?	Groups on teaching sheets had to draw symbols or write the name of their group. Why?
	U toku jednog časa koristiš više nastavnih oblika. Zašto?	During one lessons you use more classroom organizations. Why?
	Od čega zavisi koji ćes nastavni oblik organizovati?	On what does it depend which classroom organization you will chose?
	Svaka je grupa imala nastavne listiće sa različitim zadacima. Zašto?	Each group had teaching sheets with different exercises. Why?
	Primjetila sam da si grupama dala još neki zadatak osim nastavnog listića. Možes li mi malo reči više o tome?	I noticed that you gave to the groups some additional teaching sheets. Would you tell me more about it?
	U nastavi koristis razlicita nastavna sredstva. Zašto?	During the lessons you used different teaching materials. Why?
	Udžbenik matematike koristiš najviše kada zadajes zadaću. Zašto? Šta misliš o udžbeniku?	You used mathematical textbooks mostly for homework. Why? What is your opinion about the textbook?
	Primjetila sam da učenike upućujes jedne na druge i koristiš kooperativno učenje. Zašto?	I noticed that you directed the pupils to each other and used cooperative learning. Why?
	Kako razvijaš kooperativnost?	How do you develop cooperation?
Komunikacija i briga / Communication and Care	Učenik je dobilo aplauz. Zašto?	The pupil got applause. Why?
	Šta radiš s učenicima koji već znaju izračunati neki zadatak i žele to reći i pokazati?	What do you do with the pupils who already know to solve some exercise and want to say it and show?
	Kako si postigla da svaki učenik bez problema sjedi sa svakim djetetom?	How do you manage that each pupil wants to sit with other pupil without a problem?
	Za šta služe pravila ponašanja? Ko ih je postavio?	For what reasons you use the rule of behaviour? Who formulates them?

Ostale teme /Other topics	Kako odredujes koliko je potrebno vremena za pojedinu aktivnost?	How you determinate how much time is needed for a particular activity?
	Kada prekidas aktivnost?	When do you stop a particular activity?
	Primjetila sam da im ostavljaš dovoljno vremena učenicima za razmišljanje. Zašto?	I noticed that you gave enough time to the pupils for thinking. Why?
	Učenik je bilo odsutan nekoliko dana. Šta raditi s djecom koja nisu savladala gradivo?	A pupil was absent for few days. What to do with the pupils who didn't master knowledge?
	Pozvala si jednog od učenika da dođe na dopunsku nastavu. Ko ostaje na dopunskoj nastavi?	You invited a pupil to come on extra teaching lesson. Who comes on those lessons?
	Kakav odnos učenici imaju prema dopunskoj nastavi?	What is the attitude of the pupils towards extra teaching?
	Reci mi malo više o Školi u prirodi i novcu koji skupljate.	Would you tell me something more about School in nature and saving money?

Appendix 16: Composing of the Information from Multiple Sources

Table 26: Information from Multiple Sources

Observed	Interviewed	Text and material analysis
• The pupils worked on the test from the previous lesson • The teacher gave feedback to each pupil and analysed his/her success.	*Pupils are aware of that less points mean that s/he made the test worse or that maximum score mean that s/he made it excellent. Some pupils will be motivated if they realize that they need to work harder. It is very unpleasant for a pupil who doesn't have any points. However, there are other ways to avoid the pupil to feel hurt. I prefer not to write anything on a pupil's test if s/he not gets any points. It is better to let her/him do the test again with help.*	• The pupils' test weren't numerically graded. • (Legislation: in that semester the pupils' acquired knowledge was still graded descriptively.) • The pupils got points and at the end of the test there were written scales with number of points and what they represent. At the end of the test there were written: 6 – 10 sufficiently; 11 – 14 good, 15 – 18 very good, and 19 – 22 excellent. • The teacher wrote her comments to her pupils on the end of test. She wrote to one of the pupils: 'You made the test wonderful. Continue with the work as you start!' to the other pupil she wrote:" It is better than the test you made last time. I see that you have practiced, but there are still some errors on which we have to work together."
4.1.8.	4.1.2. & 4.2.1.	4.1.2.

Appendix 17: Embedded Arenas and Sub-arenas of the Modified Curriculum Relation Model

ARENAS	SUB-ARENAS											
	Challenges and how they were confronted											
	Problems	Dilemmas and possible solutions										
Frame factors	Teacher	Class	Classroom		Team work	Parents	Time table					
Assessment	Methods	Focuses		Reasons		Teacher's assessment						
Intention	Long-term objective			Short-term objectives								
Content	Syllabus			Daily-life		Connection with other subjects						
Teaching methods	Dialogic method	Demonstration		Discovering		Problem teaching		Individual teaching				
Peer support	Holistic view											
Classroom organization	Whole class approach			Group work		Individual work						
Teaching materials	Text materials			Objects		Body as medium						
Communi-cation and Care	Social-emotional atmosphere	Care		Praise		Discipline						
Other topic	Extra teaching			Extra activities								

Appendix 18: Advanced the Teacher's Trainings

Table 27: In-Service the Teacher's Trainings

Profile of advanced teacher training	Number of lessons and date	Organized by
Seminar *Health Education and Oral Health Prevention*	1999	Faculty of Dentistry, Sarajevo
Programme *Building Bridges*	12 training models 2001	International Child Institute from Canada
Training – Basis seminar	20 lessons 2001	Step by Step
Seminars *Reading and Writing for Critical Thinking*	80 lessons 2001/2002	Step by Step
Training – advanced seminar for teachers	24 lessons	Step by Step
Seminars *Reading and Writing for Critical Thinking*	60 lessons 2002/2003	Step by Step
Programme *Building Bridges* – parents education	2003	International Child Institute from Canada
Seminar *Splendour of fairy tales and art of narration*	2003	Phoenix Association for Waldorf Education
Workshops *Inclusion*	75 hours	University of Oslo
Advanced education for usage of child centred methodology	24 lessons 2004	Step by Step
Training *Education for Social Justice*	18 lessons 2004	Step by Step
Team leader of workshop on seminar *Usage of Innovations Methods in religious teaching*	2005	PPZ
Facilitator on seminar for teachers and other educators	January 2005	PPZ
Basis education for trainers and advisors *School – children friend*	24 lessons 2005	Step by Step
Trainer for usage of child centred methodology – Certificate	2006	Step by Step
Training *Democracy and Human Right*	6 lessons August 2006	CIVITAS
Training *Democracy and Human Right*	24 lessons August 2006	CIVITAS
Training *Education for Social Justice*	12 lessons 2007	Step by Step
Trainer training for usage of child centred methodology – Advanced module	17 lessons 2007	Step by Step
Realisation of workshops for music teachers	Mart 2007	PPZ

From a teacher's personal file which was conducted by school pedagogue

Appendix 19: Classroom

The classroom was situated on the last floor of the school at the end of the hallway (Photo 3). In front of the door there were shelves where pupils leave footwear (shoes, boots etc.) and get to the classroom in slippers. There was a teacher's desk on the right side of the classroom and hangers for children's jackets and other child's clothes (Photo 4).

Photo 3: Hallway

Photo 4: Teacher's desk

There were shelves (Photo 5 & 6) for teaching equipments and aids, toys, games, and books, pupils' notebooks, CD player, and other teacher's stuffs and aids.

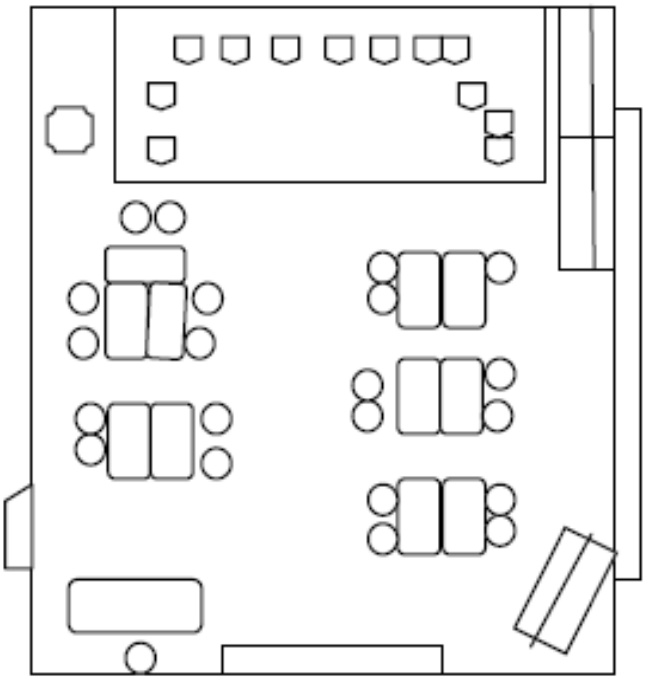
Wall sheaths (photo 7) and notice board (photo 8) with big colouring paper served to the pupils and the teacher to paste pupils' work, write how many pupils were absent, date, events etc.

Photo 5: Shelve

Photo 6: Shelve

Photo 7: Wall sheaths

Photo 8: Notice board



The pupils' desks occupied 2/3 of the room arranged in 2 rows. The desks were connected 2 by 2 so that 2 connected desks made 1 group where 4 pupils sit. The blackboard was magnetic and situated in the middle of the wall with light coming from the window from the left side. (Figure 6)

Figure 6: Classroom

There was a carpet the back with pillows for sitting (Photo 9).

Photo 9: Carpet with pillows for sitting

Appendix 20: Assessment Sheets

- Individual evaluation: Each pupil in group had to tick if s/he: finished the task, listened when others were speaking, shared ideas with others. In addition the pupil had to write what s/he could do that can help the group when they collect next time.

- Group evaluation: Members of the group together ticked whether they: finished the task, worked together, worked silently, and stayed together until the end of all tasks. They also suggested how the groups could work better.

- Teacher evaluation: The teacher ticked what she noticed, whether members of the group: exchanged ideas silently, listened to each other, stayed together until all finished the task, prised each other, helped each other, discussed whether they worked well as a group and how can group work be improved. She wrote also comments.

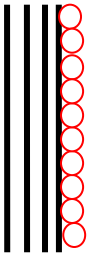
Appendix 21: Theaching Method - Demonstration

The teacher underlined, drew and encircled important elements of calculation:

- Draw wands to present tens and small circle to present ones:

4 tens  3 ones

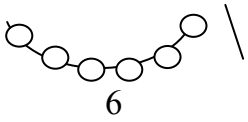
- Drew way of calculation of subtraction: 40 – 3. Teacher drew 4 wands and on the last wand10 small circles... Teacher crosses 3 circles...



40 – 3 = 30 + (10 – 3) =

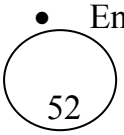
- Drew process of addition:

34 + 9 = 43



42 + 9 = 91

- Encircled to show number that has to be decomposed:



+ 8 =

- Underlined to show ones within numbers:

43 + 5 =

Appendix 22: Texts Materials

Photo 10: Additional teaching sheets

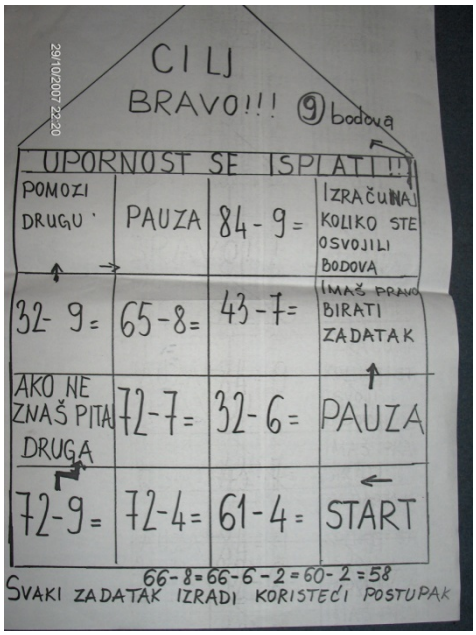


Photo 11: Game: Reach the First Line

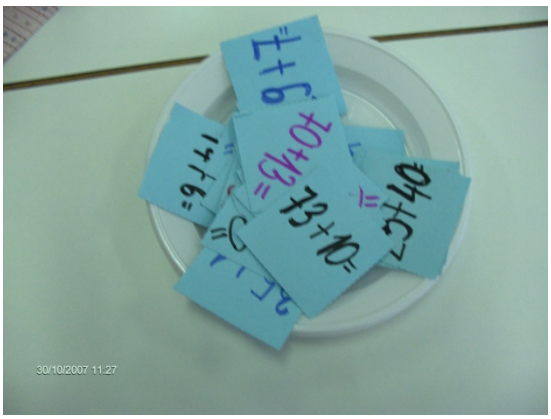


Photo 11 & 12: Cards with numerical expressions

Appendix 23: Objects

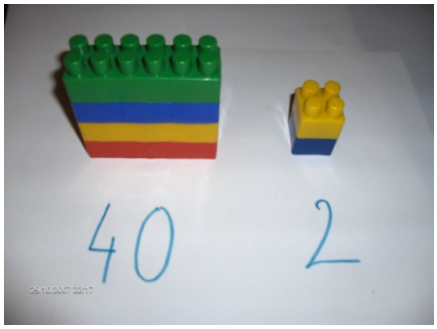


Photo 12: Toy building blocks

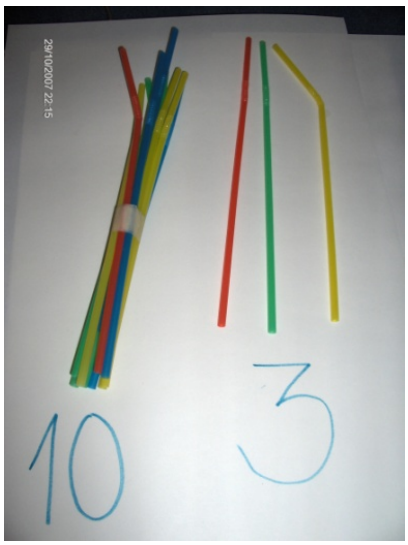


Photo 13: Straws

Photo 14: Wooden chips

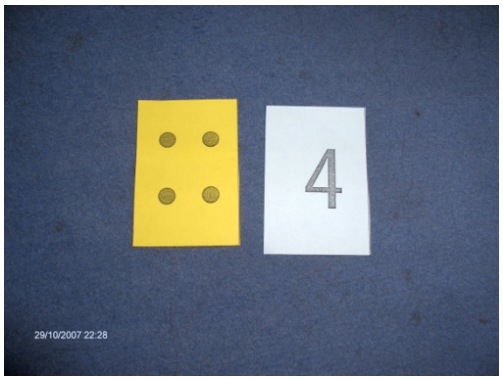
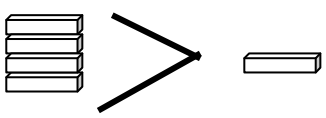
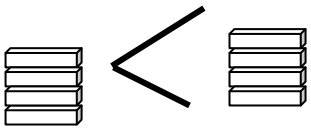
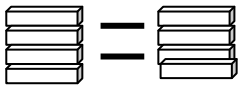


Photo 15: Money

Relation: >, < and =

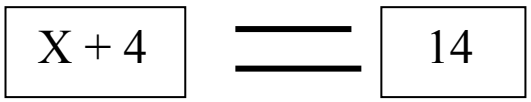


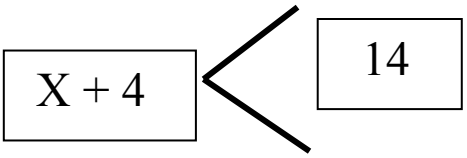




→ Toy buildings block

→ Straw





Appendix 24: Findings: Teaching and Learning of Mathematics According to the Diversity of Pupils

The study of Frame Factors showed that (1) the teacher was permanently in-service educated and that (2) the teacher loved children and her profession of teaching. Other findings demonstrated that: (3) it was the class with different backgrounds and diversity of educational needs; (4) the classroom was well equipped and the teacher was supported by the school and the parents in provision of teaching materials and aids needed; (5) the teacher worked in team with the other teacher, but also with the parents; (6) the parents helped the pupils in completing their homework; (7) the teacher used the time table and duration of the lessons flexibly with the purpose to meet pupils' interest for work and their educational needs.

The study of Assessment showed that (8) the teacher used a chain of different methods of assessment with (9) the purpose to get to know the pupils and their educational needs, as well as (10) to assess her own work. (11) The teacher used the information from the assessment to make further decisions. (12) The teacher also shared the information with the pupils.

According to the teacher, the study of Intentions revealed that (13) the pupils got possibility to progress in their own individual steps, but with (14) mutual objective to acquire the knowledge about 4 basic mathematical operations: addition, subtraction, multiplication and division.

The study regarding Content showed that (15) the teacher used contents posted by the educational authorities, but she also adapted the teaching plan to class conditions. (16) The study also indicated that the teacher connected contents to daily-life situations and (17) to other subjects with the purpose to motivate the pupils for learning and made contents more familiar to them.

The study of Teaching Methods indicated that (18) the teacher used a variety of teaching methods (19) differentiated them and (20) applied two or more of them during the same lesson. The findings also indicated that (21) teaching methods consisted of:

guiding and scaffolding, direct involvement of the pupils in tasks, direct teaching and pupils' engagements in dialogs and with materials. In addition, (22) especial attention by the teacher was given to the pupils who had some difficulties in learning.

The study of Peer Support showed that (23) the pupils supported each other during the joined activities and (24) on the teacher initiatives. (25) The teacher also supported pupils' initiatives to help each other and to work together. (26) However, the pupils also gave help each other voluntarily and (27) they took the role of teaching.

The study of Classroom Organization showed that (28) the teacher differentiated classroom organization and that (29) during one lesson she used combination of two or all of them. (30) Whole class approach was used in all sequences of the lessons by the teacher with the purposes to give the same information to the whole class and to assess the pupils. (31) The members of the groups cooperated and supported each other in solving the tasks in different ways. (32) Whole class approach and group work involved different forms while the teacher, the group and one of the pupils exchanged the teaching roles. (33) The pupils independent work on texts materials served for the purpose of assessment.

The study of Teaching Materials resulted in several findings. Those are the following: (34) the teacher utilized different teaching materials in teaching activities and she differentiated them; (35) teaching sheets were mostly used, (36) while the textbook was used seldom because teaching sheets were more appropriate in meeting the needs of the pupils; (37) the teacher employed additional teaching sheets for groups and also for the individual work; (38) teaching sheets for group work were different , while (39) teaching sheets for self-assessment were the same for all the pupils while they practiced and revised the contents, (40) the pupils had possibility to choose the additional teaching sheets after the pupils finished working on the main teaching sheets, (41) the teacher used different ways to analyse the teaching sheets, (42) the tests were used for the purposes of assessment, (39) the test was the same for all the pupils, (43) the teacher took care about the pupils' feeling when she gave feedback to each pupil and analysed

his/her success[43], (44) objects as teaching materials were used for demonstration, (45) pupils were directly involved in hand-on activities by using objects, (46) the teacher utilized daily-life situations through role-plays, (47) objects were chosen by the teacher according to their practical functions, (48) body and fingers were used as medium.

Study of Communication and Care involves the following findings: (49) positive atmosphere was ensured through enjoyable activities; (50) the teacher adapted to the pupils and supported their initiative; (51) the teacher taught the pupils how to interact positively; (52) the teacher demonstrated interests, responsibility and care about the pupils emotions, their things and physical condition, as well as classroom condition; (53) the teacher gave praise orally by expressing her satisfactions, writing on the pupils' work and applauded; (54) the teacher gave to the pupils the possibility to express their feelings and opinions; (55) the teacher paid attentions on the class discipline and to each individual pupil.

The study of Other Topics indicated that (56) the teacher introduced extra teaching lessons once a week in order to meet educational needs of the pupils. (57) In addition she organized extra teaching in continuum one week in semester. (58) Extra (out-school) activities were also inducted and (59) used with connection with ordinary lessons.

[43] This finding is in relation with arena Communication and Care.